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MISSOURI BOTANICAL GARDEN BULLETIN

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Fifty-eighth Annual Report of the Director

Volume XXXV January, 1947 Number 1

Cover: The Mausoleum in Winter.

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Missouri Botanical
Garden Bulletin

Vol. XXXV JANUARY, 1947 No. 1

FIFTY-EIGHTH ANNUAL REPORT OF THE DIRECTOR

To the Board of Trustees:

The Director of the Garden has the honor to submit his report for the year ending December 31, 1946.

The past year has been marked by an unusual number of significant events at the Garden. Even when taken individually they reflect a year of more than passing interest, and in aggregate they record at least the partial achievement of a number of long-sought goals and conquest of the obstacles that lie in the path of a public-service institution. Briefly, the most noteworthy of these are the Ellen A. Ricker bequest which was announced in the September Bulletin; the inauguration of a considerably expanded teaching program of the Henry Shaw School of Botany, which operates as a unit of Washington University; the devastation wrought by the near-tornado of September first; the dedication of the Boxwood Garden at the Arboretum by the Federated Garden Clubs of Missouri; and the transformation of the central heating system from coal to oil.

While the wounds of the storm are still all too evident in the City Garden, and will be completely healed only by time, the other events of the year voice a considerable measure of hope for the continued progress of various projects, including botanical research.

The late Ellen A. Ricker left as a bequest to the Missouri Botanical Garden approximately one quarter of her estate. Since the time of Henry Shaw's death this is the most significant contribution (which will aggregate above $100,000 according to the probate court inventory) that has ever been made to the Garden. Contrary to the still-prevalent view, no aid is received from city or state, and the annual Friends-of-the-Garden fund, while helpful, constitutes but a small part of the yearly operating expenses.

Miss Ricker's legacy comes at a most opportune time for, in spite of careful management of investments and operating expenses, the latter continue to increase at an appreciably faster rate than the former. Many tentatively planned projects of general Garden improvement must await the lead that this generous St. Louisan has set. Urgently needed at present is an addition to the Administration Building to relieve the overcrowded condition of the library and herbarium. Plans for this building project have been drawn up and now await the availability of materials—and the hope that construction costs may show a downward trend in the not-too-distant future. It is proposed to designate this the Ricker Herbarium Building as a lasting memorial to Miss Ellen Ricker.

A word may be appropriate at this point relative to the Friends-of-the-Garden fund for the past year. Aided by the Kiwanis Clubs of St. Louis and the County, under the leadership of Mr. John W. Nies, our mailing list was appreciably extended, which is largely responsible for a notable increase in receipts. The fund for 1946 reached $9,000.00, being considerably above the average for the past few years. This is encouraging, although it is still far short of the aid that is warranted by the many services that the Garden extends to the million or more inhabitants of St. Louis and vicinity.

For nearly two years plans have been gradually evolving to give the teaching facilities of the Henry Shaw School of Botany* a wider range of interests. As the final outcome of this planning the University has approved the inauguration of two entirely new undergraduate curricula: one in Horticulture and the second in Microbiology. Although the first catalogue announcing these courses was issued in August it was decided to wait another year before attempting any publicity of the program. Two new University appointees will be added to the present teaching staff of the School, but inasmuch as the new curricula could not be arranged immediately to the best advantage no attempt has been made to rush their inauguration.

In past years a number of people have voiced the view that our teaching program given in cooperation with Washington University was lacking in Horticulture—a lack that was particularly conspicuous in view of the many advantages that the Botanical Garden could offer. It is not planned, however, to develop a horticultural curriculum that will compete in any way with the large and diverse programs offered by certain other horticultural institutions. Our facilities are obviously entirely too small for this, nor does there seem to be a need for such duplication. It is hoped, rather, that the curriculum as it is set up will be one that will appeal to a select group of students who will be interested in combining a more comprehensive scientific background in the natural and physical sciences with the more practical aspects of horticulture. With all due respect to the "green thumb" gardeners whose attributes we recognize and appreciate, the basic advances in plant sciences, like all other branches of science, are becoming more specialized and technical, relying especially on basic advances in chemistry, physics, and genetics. Plant scientists who are adequately trained in this way do not exist in sufficient numbers to satisfy the present demand, and this demand may be expected to increase in the future. Thus it is the intention of the new course to prepare a limited number of especially qualified students who may be expected to become significant contributors to horticultural science.

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*For a detailed discussion of the School see the January, 1945, issue of the BULLETIN.

The curriculum in Microbiology, which is likewise offered in the new catalogue, constitutes an entirely new innovation in the School's teaching program. The role that micro-organisms, including the yeasts, bacteria, and certain molds, now play in medicine and in a considerable variety of industrial fermentation industries has created a field of productive biological investigations which necessitates special undergraduate training. Few institutions in the country offer a curriculum of this sort.

Storms of near-tornado violence are by no means unknown to St. Louis, and the Garden has been the recipient of its share of these catastrophies. The Botanical Garden lay directly in the center of the rather local but exceedingly violent storm of September 1 which swept through the central-western portion of the city. Although greenhouse damage did not approach that wrought by the storm of 1927 the damage to the outside plantings and gardens was by far the worst in the Garden's history. The shambles of broken glass, walls, uprooted and mangled trees necessitated closing the Garden to visitors for three days until the paths could be cleared and the greenhouses made safe.

The violence of the wind caused many trees to be uprooted or broken off close to the ground, while literally hundreds of others were damaged to a greater or less extent. The accompanying hail lacerated the foliage, completely defoliating some shrubs and trees and leaving most of them in a decidedly bedraggled condition. Virtually all the herbaceous plantings, most noticeably the late summer and autumn displays near the main gate, were completely riddled, and of course it was too late in the season to attempt replacement. A more complete account of the storm damage is given on a later page of this report.

The most notable progress in the Arboretum plantings during the year was the completion of the Box Garden, which was officially opened on May 9. The various varieties of Boxwood that are now growing in this garden have resulted from seeds and cuttings collected in the Balkans twelve years ago by Dr. Edgar Anderson. They were gathered in a region where the general conditions of water and temperature relations approximate those prevailing in the St. Louis region. Of the hundreds of plants that were started, a few dozens of the most promising ones have now been set out under the partial protection of the serpentine wall that was completed last year.

Most of the available commercial varieties of Boxwood find St. Louis a bit rigorous for satisfactory growth year after year, although occasionally in properly sheltered positions they will display all the advantages of this fine group of plants. The Box Garden does not represent a final planting, but is intended rather as a combination display-experimental garden, and when the best of these Balkan varieties have proven their worth a major contribution will have been made to mid-western horticulture.

As a note of formality in the opening of the Box Garden, it was dedicated by the Federated Garden Clubs of Missouri on May 9 during its thirteenth annual convention, which was held this year in St. Louis. Mrs. Robert O. Powelson, as President of the Garden Clubs, made the speech of dedication and Dr. Edgar Anderson gave a talk on the origin of the Boxwood collections.

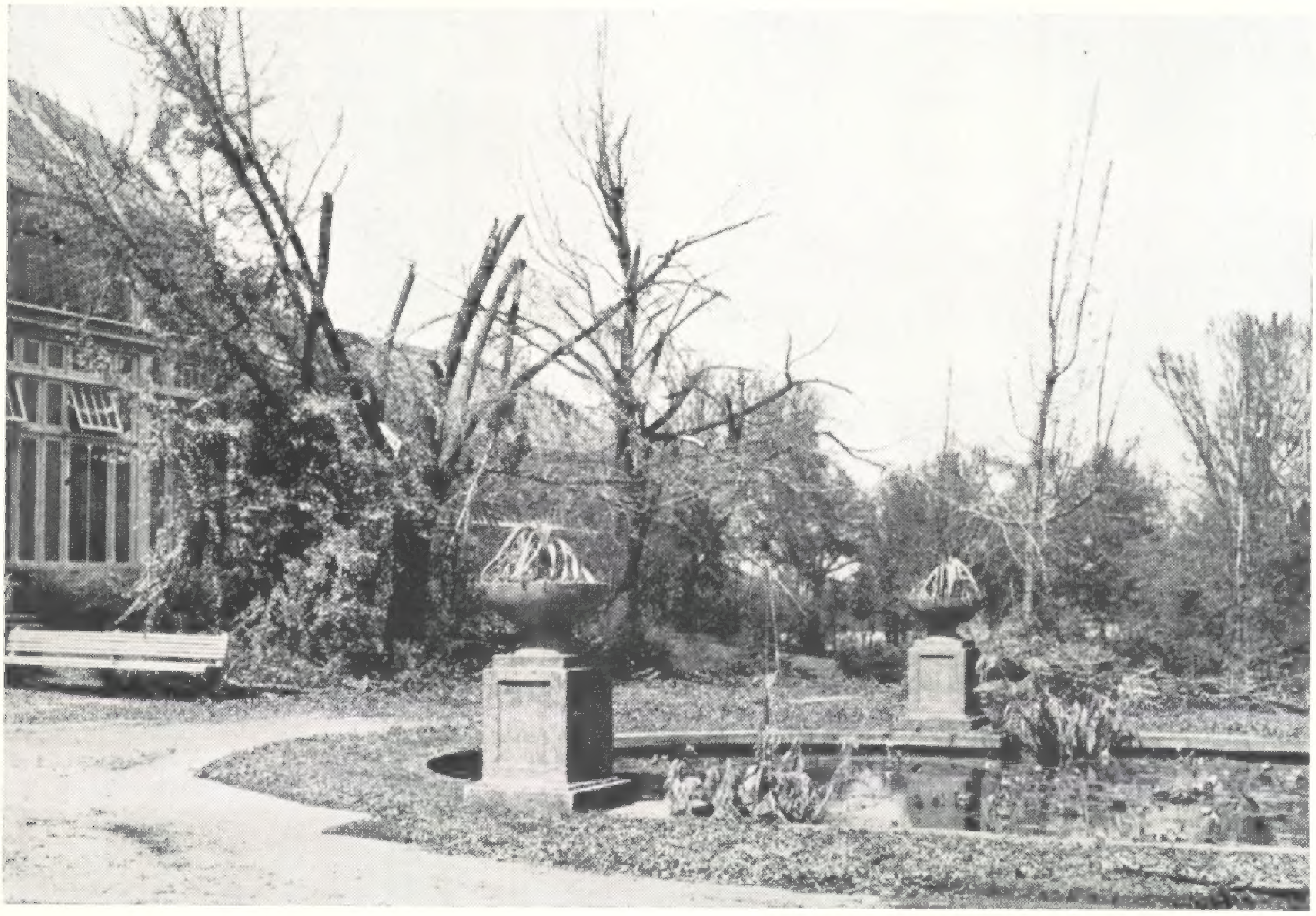
The results of the long-time program of orchid breeding have been especially gratifying during the past year. The breeding of these horticultural favorites is assuredly one aspect of botanical work in which man may make decided improvements over Nature, at least in its normal course of events. A botanist from Colombia recently remarked that our orchid flowers were much finer than those growing in the tropical jungles of her own country. Years of cross-breeding the most productive and colorful wild plants from the American tropics are now yielding hybrids that are larger and more showy than their parents. The results of this work were reflected in a small way in the bouquet that the Garden presented to the 1946 Veiled Prophet Queen—almost all of the blossoms used being from new hybrid plants grown by Dr. David Fairburn in the Arboretum greenhouses.

In June, 1945, a survey of the Missouri Botanical Garden heating system was made by Mr. A. H. Vogel, Consulting Engineer. The survey recommended that the stokers then installed in two of the three boilers be replaced by oil burners whenever the necessary equipment and materials became available. In the spring of this year the equipment was obtained and the work of converting to oil commenced as soon as the boilers were shut down for the regular seasonal overhaul. By fall it was virtually completed, and we have now had several months to observe the benefits arising out of the change from coal to oil. The automatic equipment makes it possible for one man to operate the boilers on each eight-hour shift, while with coal it was necessary to have two or more men on each shift, depending on the severity of the weather. It is expected that payroll savings alone will offset the higher cost of oil. Moreover, the two stoker-fired units formerly in use lacked the rapid pick-up that was so often demanded, but the oil burners have clearly demonstrated their ability to meet the great variations in the demand for steam due to a sudden temperature change. An extra oil burner has been purchased as standby equipment and can be installed in thirty minutes in the event of a mechanical failure to either of the existing installed burners. There is little doubt that this change of fuel has solved the serious problems existing heretofore in the heating plant.

THE STORM OF SEPTEMBER 1

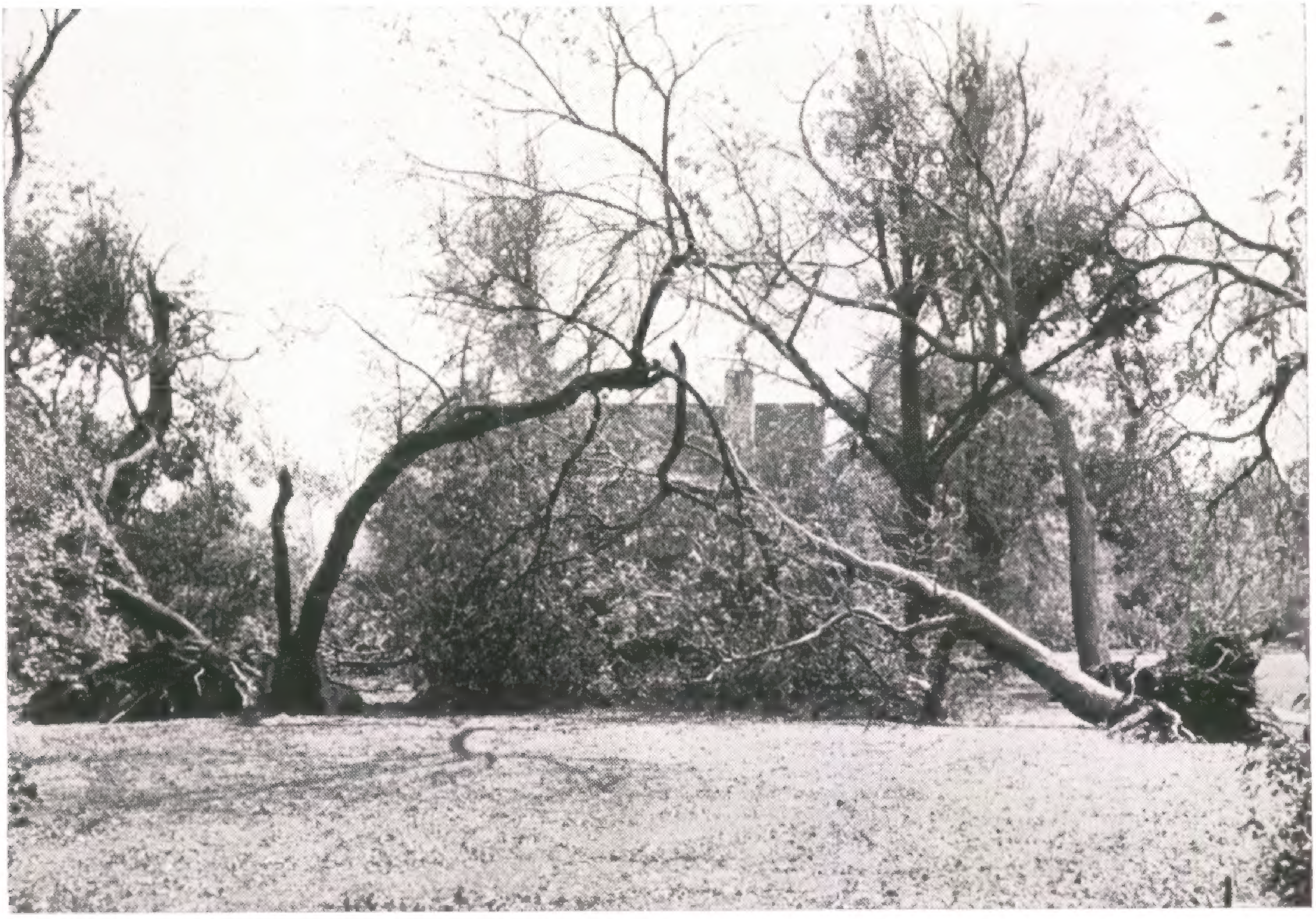
The ever-pressing burden of pruning trees was begun in the last week of August. No sooner had progress been made, however, than a violent thunder storm, accompanied by a 65-mile-per-hour wind and great quantities of hail, struck the Garden on September 1. Although the storm lasted only 20 minutes it left in its path a wake of destruction such as the Garden had never suffered before. Broken and mangled trees were strewn across the walks and lawns, pools and streams overflowed, basements flooded, stone walls were crumbled, and many lights of glass broken in the greenhouses causing a good deal of damage to the plants within.

Nearly 70 different species of trees and larger shrubs were damaged or destroyed. While some of these can be replaced readily and do not represent



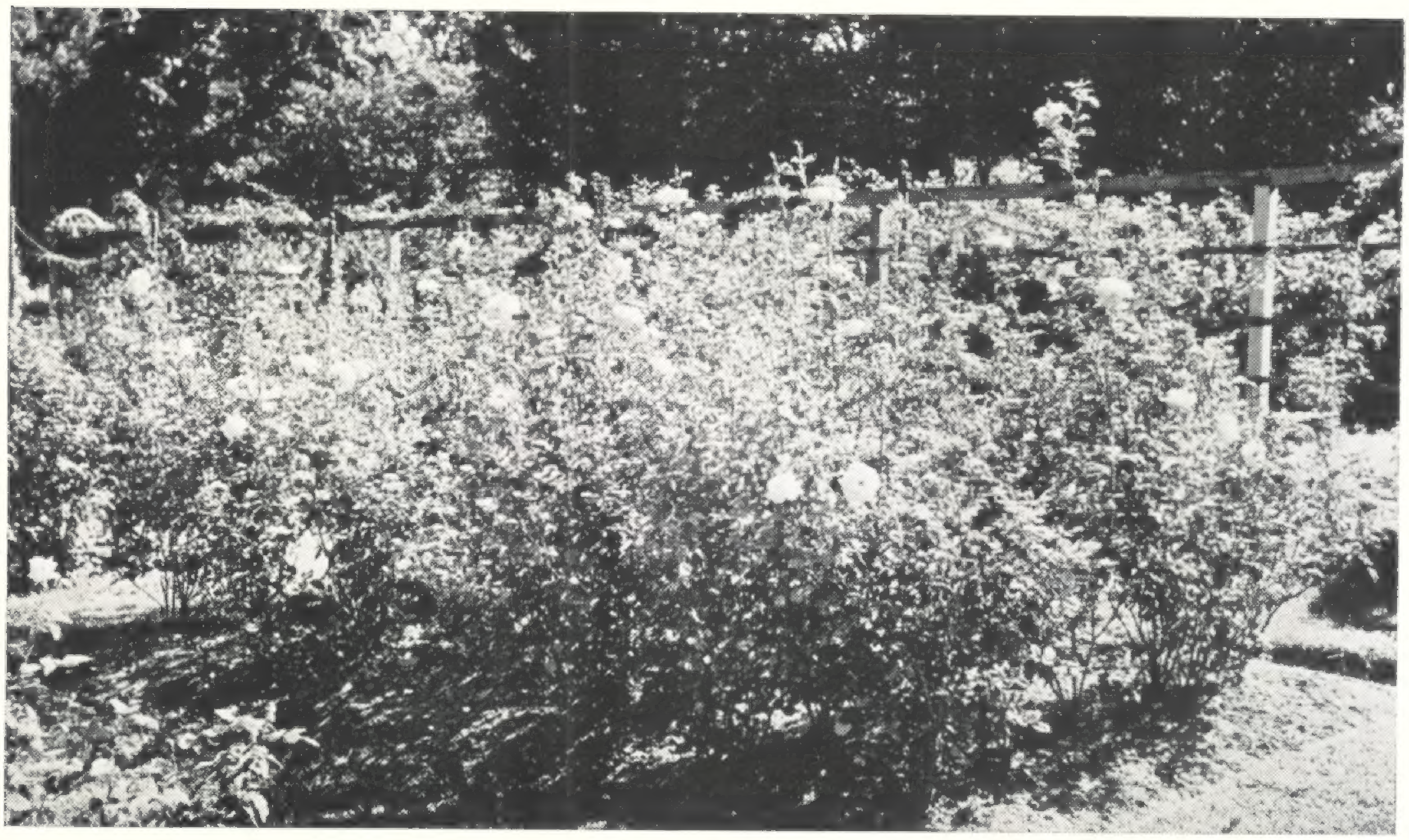
Damage done to Ginkgo trees and pool plantings by storm of September 1 a serious loss, others were rarer plants or especially fine specimens and considerable expense and many years of growing will be required to heal the scars made in the Garden.

Some concept of the litter of vegetation that had to be removed may be obtained by noting that more than 740 truck loads of brush and tractor drag-loads of limbs and trunks were hauled to the barn area. The larger trunks were then transported to Gray Summit for sawing into lumber and the remaining usable wood piled for cord-wood, while the brush was burned. Evidence of the storm is still all too apparent in the broken tops and branches of many trees throughout the Garden. The work of pruning damaged limbs is by no means completed and a number of severely injured trees still remain to be removed.

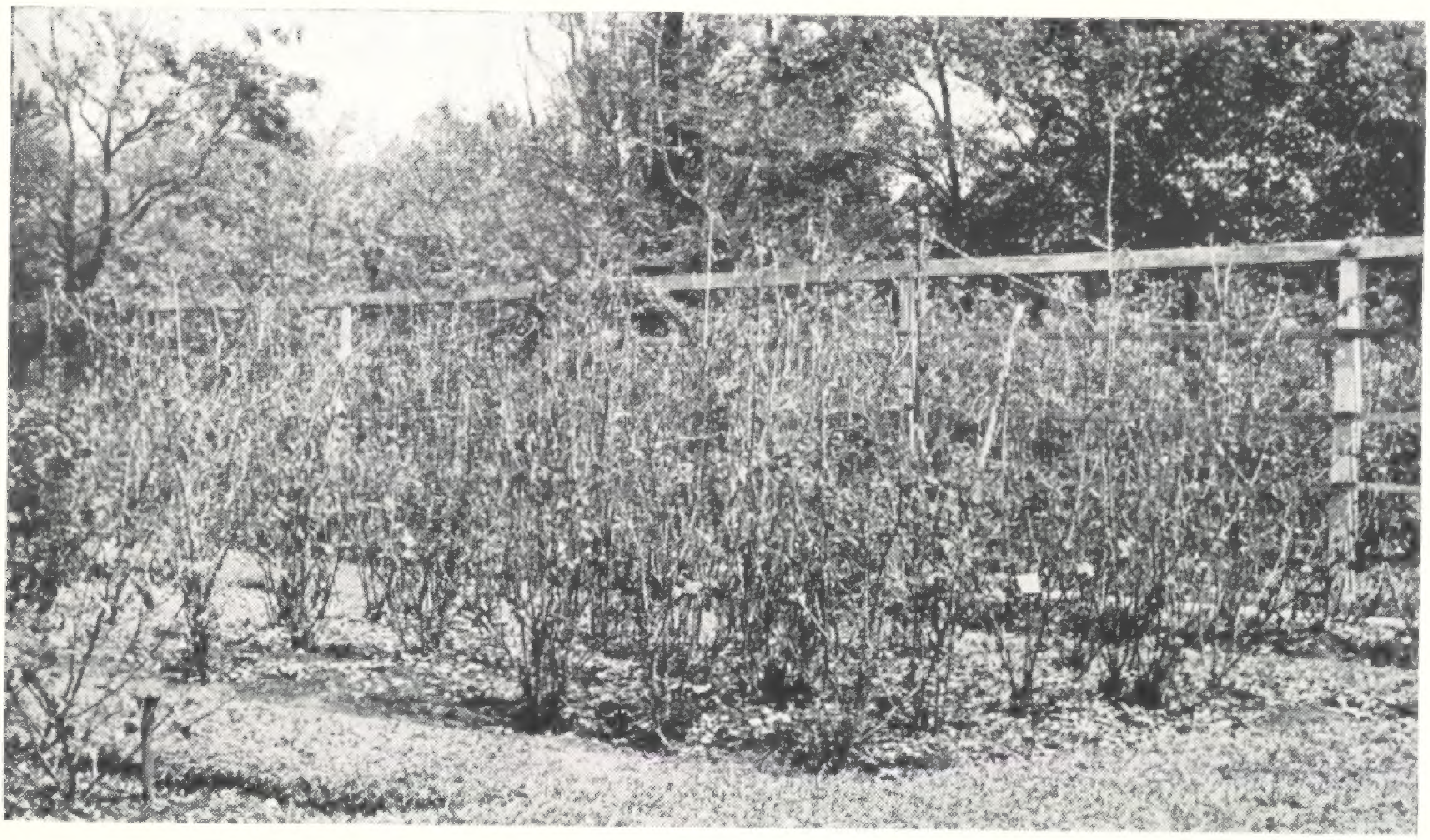


Old Catalpa trees planted by Henry Shaw

The greenhouses suffered less damage than might have been expected from the devastation that was wrought outside. A total of over 1900 lights of glass were broken, damage being especially heavy in the north ends of the main conservatory and floral display house. The storm came from the north and nearly all of the glass facing that direction was destroyed. In addition



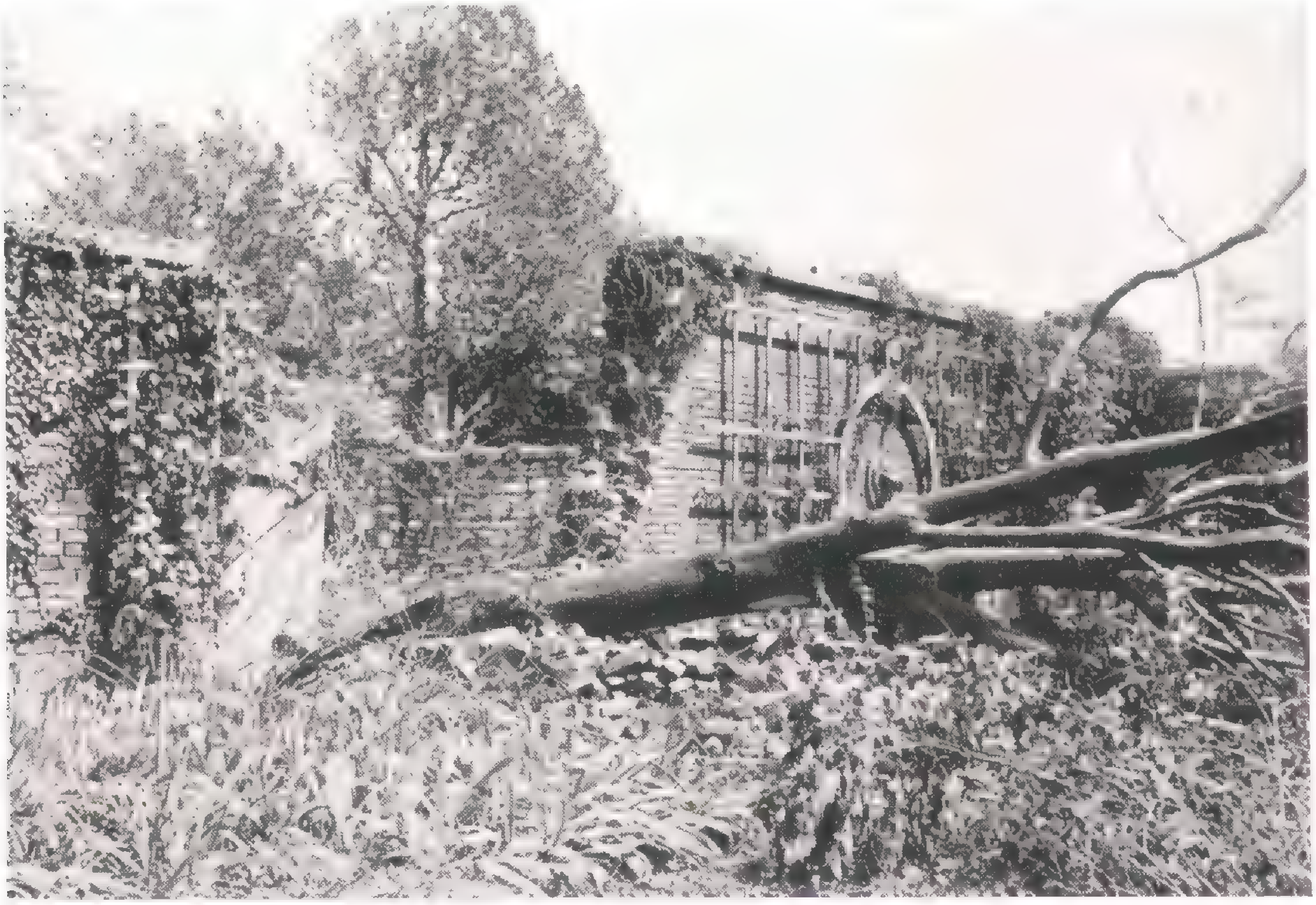
View in rose garden. Picture just happened to be taken on August 31.



Same bed of roses at 5 P. M., Sunday, September 1 to the broken glass the ventilators in both the Linnean House and Floral Display House were completely blown off.

The fall of large branches and entire trees caused considerable damage to the fences and walls. Most conspicuous was a great gap of some 108 square feet in the brick wall east of the Linnean House and a total of some 100 square feet in the stone wall along Tower Grove Avenue. Some damage was also occasioned by flooding of the boiler house, the office at the main gate, and the Assistant Engineer's residence.

While the damage to buildings and greenhouses is adequately covered by insurance, the still more severe loss suffered by the outside plantings and walls presents an unforeseen inroad on the regular budget and must be met by curtailments of other Garden operations.



Brick wall in Linnean Garden broken by falling Tree of Heaven (Ailanthus)

A disaster of this sort should be viewed in as favorable a light as possible. Many of the outside plantings were in serious need of reorganization and rejuvenation—a need of which the Garden was entirely aware yet unable to remedy due primarily to insufficient funds. Some changes now become absolutely vital and must proceed at the expense of other budgetary items if supplementary funds are not available. It presents, therefore, an excellent opportunity for those persons who may be interested in the Garden's welfare to contribute to this improved landscaping of the grounds.

SOME MINOR CONSTRUCTION PROJECTS

A number of small construction jobs were accomplished during the year which do not fall under the heading of general maintenance and seem worthy of brief note. The old, worn, and paint-soaked brick floor of the carpentry shop was replaced by a concrete floor, and the floors in the Floral Display House potting shed and in the supply room were resurfaced. In view of the change from coal to oil it was possible to resurface the coal-storage bin roof, thus covering the manholes which offers an added assurance against flooding of the power house.

The old wooden cold-frames north of the Linnean Garden, being in an advanced state of decay, were wrecked and replaced by eighteen concrete frames which may be expected to last for many years at little maintenance expense. Thirty-six new top vents were installed in the Aroid-Citrus House, three in the Cactus House, and twenty new snow guards were built for the top of the Palm Range.

Certain of the buildings and most of the greenhouses were in rather urgent need of paint. During the year the Main Gate rest-rooms and office rooms, as well as the exterior of the Museum building, were painted. A considerable portion of the Main Conservatory group was painted on the outside and the interior of the coffee house up to the roof glass. Eighty garden benches were refinished after their old paint had been burned off.

ARBORETUM

During the past several years, many varieties of yews (Taxus) have been obtained by purchase and exchange. They have proved hardy and have grown to a size suitable for transplanting to a permanent location. Some kinds have done very well at the Trail House, and the larger specimens of the new varieties were planted at the sides of the new concrete stairway. This brings together a worth-while collection in an area available to visitors.

The planting of the Boxwood Garden started in the spring of 1945 and was partly finished before cold weather set in that year. Only a few were lost during the summer, which means that the plants were given a very severe test without irrigation. Those that died were replaced in October, and at the same time some further plantings of magnolias and rhododendrons were made. In addition, a row of junipers was set out along the connecting road east of this garden, and about 300 azaleas were added to the two old plantations. Of the 49,000 gallons of water hauled for irrigation, a large part was used at the time of planting. About 500 cypress (Taxodium) were planted in a slough near the Meramec River. Numerous smaller plantings were made in the course of the year, in addition to the many plants moved from the seed-frames to the nursery. Many new plants have been received, some of which have been placed with the specimens in the observation plot.

A compost mixer was purchased, and this machine, along with the Roto-Tiller, has proved exceptionally valuable in nursery work and in the establishing of new plantations. A new trail has been laid out in the Wild Flower Reservation which, when completed, should be attractive throughout the year. It is planned to establish most of the showy plants on either side of the trail and to label the plantings so that they will be as interesting to the average visitor as the Reservation is to the specialist.

At the Main Entrance gateway, the old picket fence was removed and work begun on a new stone and iron gateway. It is planned to complete this by spring so that the extensive plantings required may be established before hot weather. A number of large trees have been moved into place, and wide use will be made of conifers and broad-leaf evergreens. It will be necessary to haul much good soil and improve that on the site before planting can be started. Blasting of rock to make room for soil is about finished, but much grading remains to be done.

Road work required considerable time since very little of it has been done the previous three years. In May all roads were reshaped and rolled, and over 500 tons of gravel were hauled and spread on the surface. An effort was made to dust-proof these roads by applying eleven tons of calcium chloride, but this treatment is not very satisfactory in a region where thirteen weeks may elapse between showers. The trucks were driven 11,700 miles during the year, this being the greatest distance they have covered since they were purchased. Most of the driving being in low gear in off-the-road work, the wear on the engine is as great as if the trucks had been driven 40,000–50,000 miles annually, and it becomes increasingly difficult to keep these ten-year-old machines operating. The tank truck hauled almost 50,000 gallons of water for irrigation, and 10,000 gallons of sludge which is used as a fertilizer.

Continued use of the cattle in grass-land improvement has reduced the mowing time by 50 per cent. A simple feed barn was completed on the farm, much of the lumber used being from our own sawmill and some salvaged when the old barns were taken down. At the new barn, a 100-ton silo was built and filled with corn silage. Feeding from this silo began in November. The trees on Crabapple Hill have now become so large that it is almost impossible to maneuver machinery between the rows. A herd of cattle placed there in the fall indicated that grazing cattle might replace the mowing operation provided it was timed so that no harm would be done to the trees. Nearly 3000 bales of hay were put up for use as a mulch and for cattle feed. During February and March 15,200 board feet of native lumber and 150 catalpa rails and posts for use at the Box Garden were sawed, requiring about seven days of operation.

Beginning with the inter-racial and the inter-demoninational Easter Sunrise Service, the Arboretum has had more use by organizations than ever before. At the Sunrise Services about 600 people gathered near the Trail House. The magnificent display of crabapples brought many visitors and many organizations. From 150 to 250 cars were counted on week-ends in the spring. Following is a list of the larger groups:

March 19, Girl Scout Leaders
May 9, Federated Garden Clubs
June 13, Florists' Club of St. Louis
June 21, Clayton Garden Club
June 23, Henry Shaw Garden-Way Association
July 14, St. Louis County Beekeepers Association
July 14, Franklin-Gasconade County Firefighter's Ass'n, Inc.
October 16, Hawbrook Garden Club
October 21, Rowena Clark Garden Club
November 6, Ozark Garden Club
November 19, American Association of Botanical Gardens and Arboretums
November 24, Phi Sigma Phi, Harris Teachers College

The management of the Arboretum is under the direction of Mr. A. P. Beilmann.

GARDENS

Beginning in 1943, the shrub beds in the vicinity of the Floral Display House have gradually been replanted. Large masses of the more common shrubs have been replaced with magnolias, redbuds, American hollies, Pfitzer's junipers, and in March twenty hybrid "mollis" azaleas and other shrubs were set out. Narcissi have been naturalized amongst the shrubs, and English ivy, Pachysandra, and *Vinca minor* were used freely as ground covers. These new plant materials have greatly improved the appearance of this part of the Garden.

The shrubbery which borders the Italian Garden was completely overhauled in the spring, the Lombardy poplars being replaced with twenty-four of the fastigiate variety of Simon Poplar and new shrubs added to the border. Azaleas and various dwarf junipers were planted in a new bed which adjoins the large group of azaleas just northwest of the Grove.

Fifteen apple trees were planted on the espaliers in the Economic Garden to replace some of the original fruit trees imported from England in 1917. Seventy-five shrubs, representing nine species, were planted in the various shrub beds on the Knolls.

For the first time in a number of years tulips were again planted in the beds in the main plaza and also in the Linnean and spring gardens.

The bedding plants, roses and perennials, in the various gardens gave fine displays of color until they were cut down by the slashing hail-storm of September 1. Many tender plants were destroyed, but others, like the roses, gradually revived and sent out lateral growths which in time produced some flowers. All woody plants are so badly scarred that it will take a year for them to outgrow the damage.

It will be interesting to see how the trees and shrubs will bloom next spring after a year of freakish weather. The spring season was as early as it has ever been. Narcissi were in full bloom on March 21, and a few days later crabapples, redbuds, and all the other early-flowering trees and shrubs were in flower. Fortunately no late frost interfered to check or damage the plants which were stimulated so early by the warm weather. As for moisture —first it was wet, followed by a dry spell in July and early August, then torrential rains beginning on August 15, when 7.84 inches of rain fell in twenty-four hours, climaxed by the rain and hail-storm on the afternoon of September 1. There then followed another dry period and again more rain, so that now, December 21, the annual precipitation totals 56.32 inches, the normal being 36.75 inches. The shrubs which lost their leaves as a result of the hail went into a resting period, and this was followed by renewed vigor which resembled that of the spring season. Early-flowering shrubs, such as lilacs and azaleas, began blooming in October, and because of the mild November weather many of the flower-buds are now half open but browned by the few hard freezes of December.

The Iris Garden was replanted in late summer and early fall. Seventeen beds comprise an area of 13,068 square feet and contain 893 clumps of iris. Forty new varieties were purchased, and the iris collection is now as up-to-date as it is possible to make it. Not every new variety is represented as soon as it is introduced because of the high price. In recent years new varieties have been chosen on the basis of the iris symposiums. One bed which had been planted according to the 1944 Symposium now contains 89 of the 100 leading varieties of iris. At current prices it would cost one hundred dollars to plant the remaining eleven iris. For example, the varieties "Alba Superba" and "Mellowglow" are listed at twenty dollars each in 1946 iris catalogues. This is probably the only garden in which an iris bed has been planted with the varieties in their numerical rank according to the votes in the symposium. Fourteen new varieties were added to the collection of peonies which forms a part of the iris garden.

Because of a cool spring and a busy season the planting of tropical water-lilies in the outdoor pools was delayed by at least two weeks. The east and west pools which are chiefly devoted to the hybrid day-bloomers originated at the Garden were again ablaze with riotous color during the summer and early fall months. The east pool was conspicuous with flowers of dark shades including deep blues, rich purples, and violets, while the west pool was notable for light hues,—pinks, whites and yellows. About 120 plants are set out yearly in these two pools. As in former years, the large circular center pool featured nine specimens of the spectacular *Victoria Cruziana* of the Amazon Region, commonly called Giant Water-platter. This is the plant with extremely large round leaves that can support the weight of a child or even a medium-sized man. They can be grown only in large pools, as the leaves average 10 to 15 feet in length, including the stalks, and there are as many as a dozen to each full-grown plant. Victorias must be grown from seed annually but fresh seeds are not necessary. Many pods are produced during the season but only a few reach maturity.

During the great storm of September 1 all the water-lilies were reduced to shreds by the accompanying wind, hail and rain. The pools presented a scene of devastation for about a week or until they were cleared of debris. Ensuing days of warm weather following the storm caused new leaves and buds to make their appearance, and three weeks later the pools were as filled with color and fragrance as if nothing had happened. Only the center pool remained bare for the Victorias were never able to recover from the shock.

All of the major directional and explanatory signs attached to buildings and along the main walks were replaced with new ones.

FLORAL DISPLAYS

Buddleias, cyclamen and primroses were displayed during January. For the first time the annual Orchid Show, in February, was held in the Aroid House instead of in the Floral Display House, the plants being placed in the four alcoves and in the west end of the house. Amaryllis, calla lilies and *Primula malacoides* were added to the Cyclamen-Primrose show during February. Azaleas, calceolarias, cinerarias, annual chrysanthemums, foxgloves, nasturtiums and schizanthus were displayed during March. At Easter time the House contained lilies and hyacinths, these being later replaced by Martha Washington geraniums.

Due to the exceptionally early season, the St. Louis Horticultural Society held its spring show on May 4 and 5, the earliest date which it has ever been held. The St. Louis Cactus Society had its first show on May 11 and 12. Many flowering plants were sent to Christ Church Cathedral for the annual flower sermon preached there on May 12. Fuchsias and hydrangeas were exhibited on May 19, and this display was followed by the summer display of caladiums starting on June 16.

The 13th Mid-West Dahlia Show, held on September 28 and 29, was by far the largest and best display of dahlias ever staged in the Floral Display House. The Veiled Prophet Queen's bouquet was exhibited on October 10, the first time since 1941.

The bush chrysanthemums, which are grown outdoors each year and potted in September, were temporarily ruined by the hail-storm. Although, a month later, it was possible to salvage about a third of the crop of 1600 plants, they were very poor. Only a few of the single-stem varieties, the cascades and basket varieties, and the specimen plants were injured by falling glass in the greenhouses. Despite the loss of so many bush plants it was possible to stage a good chrysanthemum show which lasted from November 3 until December 1. The Poinsettia Show followed on December 8 and will continue into next January.

The growing of the plants, as well as the arrangement of the floral displays, is in charge of Mr. Paul A. Kohl, Floriculturist to the Garden.

MAIN CONSERVATORIES AND EXOTIC RANGES

The two Desert Houses, which occupy the extreme west wings of the main range, have come in for their share of transformation in the past year. When the South African room was first planted in 1934 a number of African milkbushes *(Synadenium cupulare* and S. *Grantii)* were planted to fill the overhead space in the high room in the quickest possible manner. Any one acquainted with the rapid growth of Synadeniums will immediately realize what space they can take up in a few short years. The great gaps in the beds created by their removal were filled when all the outstanding spurges from the Cactus House were planted there. The transplanting of a twenty-foot *Euphorbia conspicua* and the candelabrum-like *E. Cooperi* necessitated the help of five men and required a half-day to accomplish, but the results were well worth the effort. Other Euphorbias, which could not be successfully dug up with their root systems intact, were cut off at the base, left to callous for a month or two, and then placed in their desired positions to root. Often the cuttings were five to fifteen feet tall, with or without lateral branchings.

The collection of succulents has been greatly augmented by donated and exchange plants from California nurserymen and private collectors. Earlier in the year, Ladislaus Cutak was sent to Southern California where he collected in the field and visited most of the leading cactus nurseries and private gardens. Howard Gates, of Corona, gave a valuable collection of Baja Californian Agaves and cholla-type Opuntias, as well as a few other endemics. The most remarkable was the Creeping Devil Cactus, *Machaerocereus eruca,* which has been likened to monster caterpillars on account of its manner of growth and its long whitish spines. Gilbert Tegelberg, of Inglewood, sent a number of novelties from his garden, including a good-sized *Trichocereus thelegonus,* an Argentinian counterpart of the Mexican Creeping Devil Cactus. Mrs. Florence Cariss, of La Canada, who has one of the largest general collections of succulents in California, contributed a large number of rare Euphorbias and other miscellaneous kinds. E. C. Hummel, of Inglewood, donated a group of horticultural Haworthias and allied species, while Beahm Gardens, of Pasadena, sent a specimen plant of *Chiapasia Nelsonii*, one of the loveliest of all epiphytic cacti with deep pinkish blossoms.

A small collection of Peruvian cacti was shipped from the Lima Botanical Garden through the cooperation of Mr. Russell Seibert, one of our graduate students who was engaged in rubber research work in Peru during the war. Mr. Tom Macdougall, of New York City, gave cuttings of all his Epiphyllanae collected in Mexico during his winter sojourns in that country. Among them are a number of rare or rarely seen species in cultivation, including the new *Nopalxochia Conzattianum*, a description of which will be published in 1947. As usual, a number of St. Louisians have offered us plants that had grown too large for their quarters. One of the most interesting additions received through these channels was an unusually large clustered *Hamatocactus setispinus* which had graced the home of Mr. and Mrs. Haake in Jennings for 39 years.

The Curtain Vine, *Cissus cissyoides* var. *Jacquini*, in the Cycad House, was severely pruned, only the main leaders left to carry on. A cat-walk was built in the top girders which will enable occasional pruning of the vine when necessary.

In the Banana-Coffee House most of the scarlet Waxmallow bushes *(Malvaviscus arboreus* var. *grandiflorus)* have been removed to make room for more banana and coffee plants. Heavy feeding has thickened banana stalks considerably, and plants are never without fruit. Manure, in heavy doses, has been applied to all the beds throughout the main range, and the curious Umbrella Tree, *Coccoloba grandifolia*, has responded marvelously to this treatment. The application of fertilizer in the Exotic Ranges has also brought about marked improvement in the plants grown there. The miscellaneous Aroids, Gingers, Ixoras, Clerodendrons and others have produced more lush foliage and more abundant flowers than before. The sweet-scented Frangipani and the colorful Bird-of-Paradise bushes were the outstanding bloomers. Chenille Plants *(Acalypha hispida)* bore unusually lovely long racemes of flowers, while clambering vines, like *Anemopaegma Chamberlaynii* and *Camoensia maxima*, put on delightful displays. *Clerodendron fragrans* blossomed for the first time. This is a medium-sized shrub with broad oval green leaves and dense clusters of white to pink, Gardenia-like, fragrant flowers. Like most of the big-leaved sorts, it sends out runners all over the place.

Through exchanges with Mr. Henry Teuscher of the Montreal Botanical Garden, thirteen new species in the genera Aechmea, Dyckia, Fascicularia, Hechtia, Nidularium, Pitcairnia, Tillandsia and Vriesia have been secured.

A number of unidentified Mexican Pitcairnias, Tillandsias and Vriesias collected by Mr. Tom Macdougall in the Isthmus of Tehuantepec have been received. Our tropical plant collector, Mr. Paul Allen, has sent in both seeds and small plants of various Panamanian species,—the most interesting to become established being the showy-foliaged *Guzmania musaica,* which is a much more beautiful form than the one already in cultivation. Numerous seedlings of *Aechmea Allenii* have been raised and are thriving although still very small. This new species is said to be a very showy plant both in flower and fruit and outside of our collection is unknown in cultivation.

Mr. Ladislaus Cutak is in charge of the Main Conservatories, including cacti and other succulents.

ORCHID DEPARTMENT

The transfer of orchid research work from the City Garden to the Arboretum greenhouses at Gray Summit has permitted increased experimental work, particularly by the use of hydroponics. The hydroponic house which was completed in 1945 now contains about 4,000 seedlings. A second house was built during the year and has been planted with about 5,000 seedlings. The inability to obtain peat, which is the medium for potting orchids, has necessitated the use of haydite, granite, etc.

Feeding experiments have been carried on not only with the seedlings but also with the entire collection of mature plants. An injector pump was installed in the head-house which permits the fertilizer to be pumped through the present water-pipe system. Plants in the first hydroponic house have made growth equal to our expectations judging by the demonstration in the City Experimental Greenhouse. Three plants flowered during November, only four years from the time of sowing seed.

The wooden stages were removed from the east and west bench of the Dendrobium House and converted for the use of hydroponics. The west bench was entirely planted with *Dendrobium Phalaenopsis,* while the east bench was devoted to Phalaenopsis. As an experiment to ascertain what would happen to plants when removed from town to Gray Summit during extreme heat, part of these plants were removed from the small hydroponic bench in town during the month of July when the temperature was 90°. The plants did not show any ill effects.

It is interesting to note the response to hydroponics in the genus Phalaenopsis. We had never previously grown these orchids successfully but in haydite or granite they are bearing spikes which will average fifteen flowers to a plant. *Dendrobium Phalaenopsis* has likewise shown increased growth and flowers under hydroponics. Dendrobium and Phalaenopsis are the first genera to show the results of the feeding experiments, Dendrobiums having also responded when grown in peat.

Two hundred flasks have been sown with hybrid Cattleya seed, and 90 pots have been filled with seedlings transplanted from flasks. Flowers of some 55 genera have been pollinated and show seed-pods in various stages of maturity. During the year there have been 11,300 flowering plants potted in peat, and 15,890 seedlings. Of these, 7,800 were transplanted into haydite, granite, or mixture; 4,400 in the open bench; 3,690 in peat.

Orchid plants brought in weekly from the Arboretum greenhouses have kept one or two alcoves in the Aroid House filled throughout the season. The flowers were arranged according to genera; one alcove of Cymbidiums, another of Laelias, a third of Botanicals, and the fourth Cattleyas that had been raised from seed in St. Louis. Additional displays included various other genera and species. The Brasso-cattleyas raised at the Garden were particularly fine, the white form, named "Henry Shaw," being the outstanding seedling of this cross.

The English slipper orchids were noteworthy for their size and color in comparison with the older hybrids from the D. S. Brown collection. Both groups were displayed in the same alcove in order to demonstrate the improvement by hybridization.

RESEARCH AND INSTRUCTION

Dr. Carroll W. Dodge, Mycologist to the Garden and Professor in the Henry Shaw School of Botany of Washington University, has spent much of the time available for research in identifying miscellaneous collections of lichens sent by correspondents, including large series of specimens of the Aleutian Islands, Costa Rica, Guadeloupe, northern South America, northern Argentina, the Hawaiian Islands, India, Montana, Arizona, Oklahoma, and Texas, adding many species not previously represented in the herbarium. Miss Dorothy Harper assisted in making microscopic preparations and in routine insertion in the fungus and lichen herbaria until June 1. A study of the collections of the U. S. Antarctic Expedition (Admiral Byrd's Third Expedition) has been begun. Routine determinations of human pathogenic fungi have been made as the various cultures were received.

The usual courses of instruction have been given. Mrs. Charles Heiser gave the course in general bacteriology during the summer session and Dr. Richard R. Marsh is giving the course in general bacteriology in University College.

Dr. Edgar Anderson, Geneticist to the Garden and Engelmann Professor of Botany in the Henry Shaw School of Botany of Washington University, has continued to devote the major portion of his time to a general survey of the corn plant, *Zea Mays*. With the cooperation of the Pioneer Hi-Bred

Corn Breeding Company of Iowa, which provided space and assistants for his experimental cultures and furnished the money for two graduate fellowships, it has been possible to accomplish a good deal in a short time. There is a surprising amount of prehistoric maize in the various archaeological museums of the country, and an effort is being made to examine and measure as much of this as possible. During the year the extensive collections assembled at the Museum of Ethnobotany of the University of Michigan were examined in detail, as were also those of the Ohio State Museum at Columbus.

Much of Dr. Anderson's time has been spent in directing a general survey of popcorn. Aside from one or two corn breeders, no one has ever taken popcorn seriously and the information with regards to the kinds of popcorn and their history is in a chaotic state. Through the generous cooperation of various members of the seed business it has been possible to make some headway in this morass. During the year Dr. Anderson and Mr. John Jay Finan, the holder of one of the graduate fellowships mentioned above, issued a mimeographed preliminary check-list which was sent out to the trade and to popcorn growers and breeders. The response was way beyond anything which had been hoped. As a result, authentic specimens of numerous varieties were added to the collections maintained at the Garden and definite information was obtained on a great many obscure points. It is hoped that within a few years it may be possible, through cooperative effort, to bring out a definitive check-list of American popcorn varieties in permanent form.

Dr. Anderson's survey of corn varieties from Latin America has proceeded during the year. Dr. W. H. Camp, of the New York Botanical Garden, presented a fine collection from Ecuador which has been photographed and held in cold storage while a few samples were grown and studied. In November and December, Dr. Anderson studied corn in Guatemala as a guest investigator at the Iowa Tropical Research Center in Antigua.

Dr. Robert E. Woodson, Jr., Assistant Curator of the Herbarium and Professor in the Henry Shaw School of Botany of Washington University, has continued his teaching duties at the University. His research has been concerned chiefly with studies of variation in natural populations of *Asclepias tuberosa*, the familiar Butterfly-weed, and with completion of his monograph of the genus Asclepias. He has also continued the editing, with Dr. Schery, of the "Flora of Panama," the third volume of which is now approaching completion.

Dr. Henry N. Andrews, Assistant to the Director and Associate Professor in the Henry Shaw School of Botany, has continued his research work with the Carboniferous plants of Illinois and certain Chalk-Age deposits in Idaho.

During May and June a collecting trip was made in Wyoming and Idaho with Mr. Lee W. Lenz, a graduate student in the School of Botany. A few days were spent in Yellowstone Park gathering information concerning the succession of the fossil forests that exist there. With the aid of Mr. Henry Thomas, a considerable number of fine specimens of petrified fern stems were made near Wayan, Idaho. These add appreciably to our already extensive collection of these beautifully preserved Cretaceous plants. Collections of other fossil plants were made in southwestern Idaho, most notable being a petrified bracket fungus and cones of evergreen trees which formerly grew in what is now the Owyhee Desert. These collections were made possible largely through the aid of Mr. W. A. Peters of Jerome, Idaho, and other geologists of that region.

Mr. Frederick O. Thompson has continued to send specimens from the coal fields near Des Moines, Iowa, and in September an article was published in the ANNALS dealing with certain petrified seeds found in his collections. In November the Garden acquired approximately one quarter of a ton of fine coal-ball specimens as a gift from Professor L. R. Wilson, Head of the Geology Department at Massachusetts State College. These specimens likewise came from the Iowa coal fields and may be expected to reveal still more of the ancient forests that grew there in past ages.

Dr. Carl C. Lindegren, Research Professor in the Henry Shaw School of Botany of Washington University, has devoted the greater part of his time to the cytogenetics of yeast. New advances have been made, this year, in the understanding of mitosis of the yeast cell, and a paper is now in press showing that metaphosphate is essential for the division of the chromosomes. A new theory of the nature of the gene and its mechanism of action has been evolved as a result of the genetical work. A new method of studying yeast growth has been invented which promises to be of considerable practical value.

The work on yeast genetics is being carried on in the laboratory of Rebstock Hall and has been supported by grants from Anheuser-Busch, Inc., American Cancer Society, and by direct aid from Washington University. The staff includes Mrs. Gertrude Lindegren, Mrs. Amy Pabor, Mr. George Kline, Mrs. Jean Nicholson Meyer, Caroline Raut, and four part-time student assistants. Dr. Folke Skoog worked four months in the laboratory, and Dr. Michael Duodoroff, of the University of California, six weeks. Manuscripts containing their work with Dr. Lindegren were prepared, and the paper with Dr. Skoog is now in press. Dr. J. M. Wiame, of the University of Brussels, has been carrying on a joint study.

Foreign visitors who have spent a few days in the laboratory studying the new techniques of yeast hybridization include: Dr. Holger Jorgensen, Copenhagen, Denmark; Dr. Lundin, Stockholm, Sweden; Dr. Lartarjet and Dr. Roger Gautheret, Paris, France; Dr. M. J. D. White and Dr. Virden, London, England, and many others.

Dr. Robert W. Schery, Research Assistant to the Garden and Assistant Professor in the Henry Shaw School of Botany of Washington University, after three years with the Rubber Development Corporation in Brazil, resumed his duties at the Garden in January. Some plants collected in tropical Brazil during his stay there were determined, and labels for this collection were made ready for future determinations. Cooperating with Dr. Hampton, of the Allergy Laboratories of Washington University Medical School, a display of hayfever plants was set up for the general public in the entrance of the Floral Display House, various plants being exhibited from March until July as they came in flower. Dr. Schery also helped prepare a full-page rotogravure on hayfever plants for the *St. Louis Post-Dispatch.*

Courses in economic botany, systematic botany and dendrology were given by Dr. Schery during the summer at the University of Wisconsin. In the fall he gave the course in Botany 1 at Washington University. With Dr. Woodson, two parts of the Orchidaceae of Panama were edited, which appeared as Fascicles 2 and 3 of Volume III of the "Flora of Panama" in the February and November numbers of the ANNALS. Manuscript was also prepared for the Leguminosae of Panama to be contained in a future volume of the "Flora."

Mr. Paul H. Allen, Tropical Plant Collector for the Garden, returned from his wartime duties with the Rubber Development Corporation in March. He is now stationed at Gamboa, Canal Zone, and is engaged in making collections primarily for the "Flora of Panama." Mr. Allen's specimens also will be used as exchange material with other botanical institutions.

Dr. Gustav A. L. Mehlquist, Horticulturist to the Garden and Associate Professor in the Henry Shaw School of Botany of Washington University, has devoted his research during the year to genetical studies in the genera *Antirrhinum*, *Chrysanthemum*, *Delphinium*, and *Dianthus*. About 7000 plants of *Dianthus "Heddensis,"* a hybrid between *D. chinensis* and *D. Heddewigii*, and 5000 plants of hybrids involving *D. arboreus*, *D. chinensis*, *D. Heddewigii* and *D. superbus* were grown at the Arboretum at Gray Summit during the summer. Due to the fact that June and July were rather dry months the plants did poorly until late in the season. Cuttings were rooted from some fifty of the most promising plants for further tests in the City Garden. The whole block of plants will be left for another season for additional data as to winter hardiness, drought resistance, etc. It is hoped that selections of pinks suitable for the Missouri conditions can be obtained from this planting.

The space in the Experimental Greenhouse that was not used for the annual course in horticulture was devoted to genetical research. Some 800 advanced hybrids between the red-flowered *Delphinium cardinale* and *D. elatum*, one of the common garden delphiniums, were grown during the spring and early summer. The results brought us one step nearer to the desired red- or pink-flowered garden delphinium. Diploid and tetraploid carnations have been increased during the year to provide material for comparative studies of inheritance in diploids and tetraploids. Some 600 tetraploid snapdragons, all derived from a simple spontaneous tetraploid that occurred in a cross between two diploids, have been grown during the year. The segregations for flower color and other characteristics proved so interesting that a large population of diploids from the same cross are now being grown in order to provide a more accurate basis for evaluating the segregations obtained in the tetraploids.

In cooperation with Mr. Paul Kohl, breeding work with Chrysanthemum was undertaken in an effort to obtain a greater range of color and flower size in the cascade and basket types. To that end crosses were made between good cascade types such as "Anna" and "Jane Harte" and colorful non-cascaders such as "Red Melba" and "Red Radiant." Altogether, about 1300 seedlings were grown. From these, twenty-five promising seedlings were selected for trial another year.

The annual course in Horticulture was given from February 5 to May 7. As in previous years there were more applicants than could be accommodated in the space available in the greenhouse. A course in Plant Breeding was given for the first time this year (September 6 to December 19). The enrollment of nineteen students for this course was considered very good considering its rather technical nature.

Degrees.—At the June 1946 commencement the degree of Doctor of Philosophy was conferred upon Lillian Nagel, B.S. University of Illinois and M.S. University of Colorado (Cytogenetics). The degree of Master of Science was conferred on Ellen M. Kern, A.B. Washington University (Morphology and Genetics).

Graduates and Fellows:—The following graduate students in botany were registered in the Henry Shaw School of Botany in 1946:

Graduate Assistants (half-time graduate students): Richard W. Holm, A.B. Washington University (Taxonomy); Daniel McClary, B.S. and M.S. Southeastern State Teachers' College, Durant, Oklahoma (Mycology).

Henrietta Heerman Scholars: Anna Caroline Raut, A.B. Cornell University (Microbiology); Russell J. Seibert, A.B. and M.S. Washington University (Taxonomy).

Van Blarcom Scholar: Dorothy Carolyn Harper, A.B. Oklahoma Agriculture and Mechanical College (Taxonomy).

Pioneer Hi-Bred Corn Co. Fellow: John Jay Finan, A.B. Washington University (Romance Languages and Botany).

Independent Graduate Students: Robert Baxter, A.B. Washington University (Morphology); Lee Wayne Lenz, A.B. Montana State College, M.S. Louisiana State University (Genetics); Fred G. Meyer, A.B. and M.S. Washington State College (Taxonomy); Gerald B. Ownbey, B.A. and M.A. University of Wyoming (Taxonomy); Jonathan B. Sauer, A.B. University of California, Berkeley (Genetics).

Published Articles.—

Allen, Paul A.: *Pescatorea cerina.* Mo. Bot. Gard. Bull. 34:257-258; South American Arrow Poisons. Mo. Bot. Gard. Bull. 34:234-241.

Anderson, Edgar: The Blue of the Blue Ash. Mo. Bot. Gard. Bull. 34:99-100; Daffodils for the Garden. Mo. Bot. Gard. Bull. 34:63-66; Maize in Mexico—A preliminary report. Ann. Mo. Bot. Gard. 33:147-247; More about Balkan Ivies. Mo. Bot. Gard. Bull. 34:142-143; Narcissus "Moonshine" as a Variety for Forcing. Mo. Bot. Gard. Bull. 34:210-211; What is a Tetraploid? Mo. Bot. Gard. Bull. 34:43-48; Who was Who? Mo. Bot. Gard. Bull. 34:59; with Earl Hornback: A Genetical Analysis of Pink Daffodils —A Preliminary Survey. Calif. Hort. Soc. Jour. 1945:1-11.

Andrews, Henry N.: Ancient Plants of the West. Mo. Bot. Gard. Bull. 34:85-89; The Arboretum of Wide Benefit to the State. Garden Forum 8^4:4; Bonsai. Mo. Bot. Gard. Bull. 34:144-146; Coal Balls—A Key to the Past. Scientif. Month. 62:327-334; A Colorful Greenhouse Vine. Mo. Bot. Gard. Bull. 34:78-81; Craters of the Moon. Earth Science Digest 1^4:3-6; The Empress Tree. Mo. Bot. Gard. Bull. 34:157; A Fossil-hunting Trip in the Wayan District. Soda Springs Sun [Idaho], July 16; Missouri Botanical Garden. Parks and Recreation 29:297-302; Onions are Easy to Grow. Mo. Bot. Gard. Bull. 34:60-61; St. Louis To-day. Scientif. Month. 62:263-266; Soil Fertility and Organic Gardening. Mo. Bot. Gard. Bull. 34:93-94; Yews in St. Louis. Mo. Bot. Gard. Bull. 34:58; with Jules A. Kernen: Contributions to Our Knowledge of American Carboniferous Floras. VIII. Another Medullosa from Iowa. Ann. Mo. Bot. Gard. 33:141-146; with Ellen M. Kern: Ibid IX. Some Petrified Seeds from Iowa. Ann. Mo. Bot. Gard. 33:291-306; with Lee W. Lenz: The Gallatin Fossil Forest. Ann. Mo. Bot. Gard. 33:309-313.

Beilmann, A. P.: The Catalpa—An Interesting Tree. Mo. Bot. Gard. Bull. 34:96-99; Feeding Trees. Better Homes and Gardens 25:128; Keeping the Soil Where it Belongs. Mo. Bot. Gard. Bull. 34:195-201; The Liquid

Feeding of Trees. Trees 6:9-10; Maintaining Soil Fertility at the Arboretum. Mo. Bot. Gard. Bull. 34:89-93; Transplanting Trees in Midsummer. Mo. Bot. Gard. Bull. 34:94-96.

Clark, Robert B.: The Chinese Scholar Tree. Mo. Bot. Gard. Bull. 34:213-215; A Selection of Trees for St. Louis and Vicinity. Mo. Bot. Gard. Bull. 34:219-234.

Cutak, Ladislaus: Is there Palatable Water in the Barrel Cactus? Mo. Bot. Gard. Bull. 34:182-189; *Peniocereus Fosterianus*, a New Unique Species from Old Mexico. Jour. Cactus & Succulent Soc. Amer. 18:19-25; Succulents for the Home Gardener. Home Gardening 6:300-301; Spine Chats. Monthly contribution in Jour. Cactus & Succulent Soc. America, vol. 18.

Fairburn, David C.: Cultura des Orquidees em Cascalho. Orquidea 74:145-161 (translated and reprinted from "Gravel Culture of Orchids" in Mo. Bot. Gard. Bull.); Germination Period for Garden Seeds. Mo. Bot. Gard. Bull. 34:66-69; Growing Plants. II. Vegetative Propagation. Southern Florist & Nurseryman 58^{39}:5, 6, 45; 58^{40}:5-6, 13-14; 58^{41}:8, 9, 12 (reprinted from Mo. Bot. Gard. Bull.); Plants for Shady Gardens. Mo. Bot. Gard. Bull. 34:103-111 (reprinted in Modern Cemetery 56:80-81); Scented Geraniums. Mo. Bot. Gard. Bull. 34:261-262; with George H. Pring: Orchids. Monthly contribution in Gard. Chron. Amer. Vol. 20.

Kohl, Paul A.: Good Lawn Management. Mo. Bot. Gard. Bull. 34:178-182; Twilight Fragrance. Mo. Bot. Gard. Bull. 34:139-141.

Lenz, Lee W. (with Henry N. Andrews): The Gallatin Fossil Forest. Ann. Mo. Bot. Gard. 33:309-313.

Lindegren, Carl C.: Additional and Corrected Data on the Respiratory and Fermentative Activity of Yeasts containing Stored Reserves. Archiv. Biochem. 9:353-359; Breeding Yeasts for Their New Role in Nutrition. Mo. Bot. Gard. Bull. 34:37-43; A New Gene Theory and an Explanation of the Phenomenon of Dominance. Nat. Acad. Sci. Proc. 32:68-70; Sex in Yeast and Flavor in Beer. Brewers' Digest. December 1946; Yeast Genetics (Condensation of Bact. Rev. article). Amer. Brewer. December, 1946.

Mehlquist, Gustav A. L.: The Ancestors of Our Present-day Cymbidiums. Mo. Bot. Gard. Bull. 34:112-135 (reprinted as a supplement to Amer. Orchid Soc. Bull.); "Booster" and "Starter" Solutions for Pot Plants. Mo. Bot. Gard. Bull. 34:201-203; Rabbits and Pinks. Mo. Bot. Gard. Bull. 34:258-260; Tetraploidy and Pinks. Mo. Bot. Gard. Bull. 34:48-58.

Nagel, Lillian: A Cytological Study of Yeast *(Saccharomyces cerevisiae)*. Ann. Mo. Bot. Gard. 33:249-288.

Pring, George H. (with David C. Fairburn): Orchids. Monthly contribution in Gard. Chron. Amer. Vol. 20.

Schery, Robert W.: The Barrel-bellied Tree of Brazil. Nat. Hist. 55:219;

The Brazilian Toad. Nat. Hist. 55:245; Brazil's Old "Wildwest." Mo. Bot. Gard. Bull. 34:74-77; Chocolate Country of the Americas. Mo. Bot. Gard. Bull. 34:147-153; A Conservationist Views the Tropics. Mo. Bot. Gard. Bull. 34:154-157; Strangler Figs. Nat. Hist. 55:438; with Robert E. Woodson, Jr.: Flora of Panama. Part III. Fasc. 2. Ann. Mo. Bot. Gard. 33:1-140, Fasc. 3, 315-404.

Woodson, Robert E., Jr.: About Gloxinias. Mo. Bot. Gard. Bull. 34:247-258; Amsonias. Mo. Bot. Gard. Bull. 34:158-159; Apocynaceae and Asclepiadaceae, in H. N. Moldenke's Contributions to the Flora of Extra-tropical South America. Lilloa 11:193-195; Memorabilia Filicum Panamensium. Amer. Fern Jour. 36:82-89; with Robert W. Schery: Flora of Panama. Part III. Fasc. 2. Ann. Mo. Bot. Gard. 33:1-140, Fasc. 3, 315-404.

Scientific and Popular Lectures.—

Dr. Edgar Anderson, Geneticist to the Garden: January 28, at Des Moines, Iowa, before seminar of the Pioneer Hi-Bred Corn Co., "Genetics of Kernel Shape and Kernel Texture"; May 9, Federated Garden Clubs of Missouri, Gray Summit, "Story of the Boxwood Garden"; May 3, joint meeting of Phi Beta Kappa and Sigma Xi, "Role of Science in Post-War Education"; May 10, led group discussion on "Flora of Ozarks" at Webster Groves Nature Study Society; August 12, Men's Garden Club of Des Moines, "Sunflowers."

Dr. Henry N. Andrews, Paleobotanist to the Garden: before Paleobotanical section, Botanical Society of America, meeting in St. Louis, March 28, "Pennsylvanian Floras of the Middle West," and March 29, "The Tempskyas of Idaho"; April 9, the Brentwood Kiwanis Club, and April 23, the Webster Groves Kiwanis Club, "The Missouri Botanical Garden"; May 24, Wellston School Parent-Teachers' Association, "Four Seasons at the Missouri Botanical Garden"; November 15, Group 1 of the Webster Groves Garden Club, "Plants of the Past."

Mr. August P. Beilmann, Manager of the Garden Arboretum: January 4, before the Western Association of Nurserymen, Kansas City, "Tree Feeding"; April 26, the St. Louis Commercial Club, "Floral Displays in the Arboretum"; August 20, Washington, Mo., Lions Club, "The Arboretum and Its History"; September 9, Union, Mo., Lions Club, "History of the Arboretum"; November 1, Missouri Academy of Science, "Behavior of a Watershed when Both Engineering and Biological Methods are Used to Control Floods."

Mr. Robert B. Clark, Arboriculturist to the Garden: November 9, before Group 9 of Webster Groves Garden Club, "Shrubs."

Mr. Ladislaus Cutak, in charge of Succulents at the Garden: January 18, before Group 5 of Webster Groves Garden Club, "Plant Hunt in Old Mexico"; January 30, Webster Groves Garden Clubs, February 5, St. Clair County Garden Club, Belleville, Ill., February 15, Better Gardens Club of Greater St. Louis, "Cacti and Succulents"; March 8, Founders Circle of Rosemary Garden Club, Pattonville, Mo., "Gardens of Florida"; March 10, Henry Shaw Cactus Society, "Vagabonding in the Southwest"; March 26, Kiwanis Club of Northwest St. Louis, and April 1, Northwoods Garden Club, "Plant Hunt in Old Mexico"; April 14, Southern California Cactus Exchange, Los Angeles, "Missouri Botanical Garden in the Four Seasons"; May 24, Kiwanis Club of the South Side, "Shaw's Garden, Attraction of the Midwest"; July 14, Franklin-Gasconade County Firefighters Association, at Gray Summit, September 20, Botany Group, Webster Groves Nature Study Society, October 2, Art Section of Scottish Rite Woman's Club, October 22, Woman's Auxiliary of St. Marks Church, November 8, Highland Wayfarers, and November 20, Wright District Garden Club, Clayton, Mo., "Plant Hunt in Old Mexico"; September 9, Chevy Chase Garden Club, at Clayton, Mo., "Gardens of Florida"; October 22, Business and Professional Woman's Club of Y.W.C.A., "Exploring Texas with Camera and Tripod"; November 17, Amateur Cactus Society of Illinois at Chester, Ill., "Cacti and Succulents."

Mr. Paul A. Kohl, Floriculturist to the Garden: January 10, before the Talisman Circle of the Rosemary Garden Club, "The Four Seasons in the Missouri Botanical Garden"; April 9, St. Louis College Club, "Spring Gardening"; June 6, Winstanley Garden Club, East St. Louis, Ill., "The Four Seasons in the Missouri Botanical Garden"; September 20, Group 5 of the Webster Groves Garden Club, "Chrysanthemums"; September 29, visitors to the Mid-West Dahlia Show, "Four Seasons in the Missouri Botanical Garden"; October 4, Group 8 of the Webster Groves Garden Club, "Rhododendrons and Azaleas."

Dr. Carl C. Lindegren, Research Professor: January 26, took part in the Mutation Panel of the Committee on Growth, American Cancer Society, New York, and February 14, in the Botany Panel, Committee on Growth of the American Cancer Society, Washington, D. C.; March 29, American Genetic Society of the American Association for the Advancement of Science, St. Louis, "Cytoplasmic Effects and Chromosome Maps in *Saccharomyces cerevisiae*"; May 6, American Brewing Chemists, Milwaukee, Wis., "Sex in Yeasts and Flavor in Beer"; July 2, Carnegie Symposium on Variation of Micro-organisms, at Cold Spring Harbor.

Dr. Gustav A. L. Mehlquist, Horticulturist to the Garden: February 5, before the Greater St. Louis Association of Gardeners, "Some Experiences in Plant Breeding"; May 3, St. Louis Horticultural Society, "The Origin of

New Garden Plants through Hybridization"; November 6, before the Greater St. Louis Flower Growers' Association, "If I Were a Carnation Grower."

Mr. George H. Pring, Superintendent of the Garden: January 8, before the Northwoods Garden Club, "Orchids"; January 15, the Nature Study and Garden Club of Terre Haute, Ind., "Four Seasons in the Garden"; February 1, the Oak Ridge Garden Club, Chicago, Ill., "Four Seasons in the Garden"; February 21, Parent-Teachers' Association of Stix School, "Activities of the Missouri Botanical Garden"; March 4, University City Rotary Club, "Romance in Flowers"; March 7, Grantwood Garden Club, "Fantasy in Orchids"; March 12, Guild Meeting of Normandy Presbyterian Church, "Orchids"; March 26, in the N.B.C. Studio, New York, "Orchid Explorations in the Andes"; April 9, Business and Professional Women's Club, at Y.W.C.A., "Fantasy in Orchids"; April 15, Men's Garden Club of Webster Groves, conducted Garden Clinic; April 24, Men's Garden Club of Maplewood, "Four Seasons in the Garden"; May 17, Civitan Club, "Mr. Shaw's Garden"; July 23, Rotary Club of DeSoto, Mo., "Mr. Shaw's Garden"; September 17, St. Louis Women's Auxiliary to the Railway Mail Association, "Fantasy in Orchids"; October 1, Members 22nd District Illinois Federation Women's Clubs, Nashville, Ill., "What the Federated Clubs Can Do for the Community"; December 4, Spotlight Dinner of Civic League of Business and Professional Women, "Recognition in Originating New Water Lilies."

Dr. Robert W. Schery, Research Assistant to the Garden: October 10, before the Webster Groves Garden Club, "Gardens of Eastern Brazil"; October 31, regional meeting of State Federated Garden Clubs, "Shrubs."

Mr. Russell J. Seibert, Graduate Student at the Garden: October 19, before the 75th annual convention of the Illinois State Grange, at Hotel Statler, "Latin American Efforts to Develop a Rubber Industry"; October 19, Shiloh Valley Grange, and November 23, Turkey Hill Grange, near Belleville, Ill., "Peru, the Land of the Inca."

THE HERBARIUM

The regular activities of the herbarium during 1946 have gone forward in usual manner. Prewar conditions are gradually coming back; and it is evidenced by the accessions of several foreign consignments of important collections of exotic plants. It is of interest to note that among the following enumeration of acquisitions a goodly number of plants have been received from remote parts of the world—such, for instance, as the southeastern coast of Greenland, faraway New Caledonia, Australia, Alaska and Antarctica.

New Accessions: Academy of Natural Sciences of Philadelphia, 18 plants of northwestern United States; Bailey Hortorium, 39 specimens of *Hedera*;

F. A. Barkley, 125 plants of Alaska and 135 plants of northern Mexico; Mrs. Nettie Mae Bauer, 3 plants of horticulture; Miss Violet Bauer, 6 plants of horticulture; Mrs. Pamela Beard, 303 plants of British West Indies; Bernice P. Bishop Museum, 55 lichens of Hawaii; Miss Lydia Bourgere, 1 plant from Louisiana; Brother Allyre, 14 lichens of Quebec; Butler University, 86 plants of Indiana; M. Quirós Calvo, 28 fungi and lichens of Costa Rica; Chicago Natural History Museum, 675 plants of Central and South America; R. T. Clausen, 3 plants of New Mexico and Panama; Sam Coffin, 2 plants of Missouri; H. S. Conard, 1 plant from Colorado; Conservatoire Botanique, Geneva, 100 plants of the Mediterranean region; William B. Cooke, 35 specimens of Micobiota of North America, Fasc. 6; L. Cutak, 2 cacti of Mexico; H. C. Cutler, 72 plants of Oklahoma and Utah; Robert Darrow, 39 lichens of Arizona; Otto Degener, 106 plants of the Bahamas and Hawaii; C. W. Dodge, 136 plants of Costa Rica and Panama; L. M. Dougan, plant of Ohio; Dudley Herbarium, 3 plants of western United States; Florida Agricultural Experiment Station, 8 plants of Florida; Helena Forbes, fruit of *Raphia vinifera* from South Africa; H. S. Gentry, 2 plants of Mexico; Gray Herbarium, 23 plants of Brazil; Abul Hamil, 30 lichens of India; Dorothy Carolyn Harper, 345 plants of Colorado; A. W. Herre, lichen from Brazil; K. E. Hartmann, 1 plant of horticulture; Charles Heiser, 51 plants of Arizona and California; Miss Clara Heising, 2 plants of horticulture; F. J. Hermann, 58 plants of Maryland, Virginia and Colombia; A. L. Hershey, 10 plants of New Mexico; C. L. Hitchcock, 1216 plants of Montana; L. Hubricht, 2 plants of Virginia; Juan Hector Hunziker, 78 plants of Argentina; Inst. Miguel Lillo, 90 lichens of Argentina; Duane Isley, 9 plants of Alabama and Iowa; Jardin Botanique, University of Montreal, 2 lichens of Quebec; A. L. Kammerer, plant of horticulture; A. Krapovickas, 171 plants of Argentina; James Kucynak, 5 lichens of Quebec; J. Mackenzie Lamb, 26 lichens of Antarctica; Roy Latham, 5 lichens of New York; O. S. Ledman, *Panax quinquefolium* from trade; E. S. Lutrell, 268 lichens of Virginia; Frank McFarland, 2500 plants of Kentucky; Rogers McVaugh, 5 *Asclepias* of Texas; H. M. Moldenke, 2 plants of Ecuador; National Herbarium, Botanical Gardens, Sydney, 25 plants of Australia; New York Botanical Garden, 201 plants of Nevada, California, and Mexico, and 500 photographs of *Arnica;* Mrs. Karl R. Oakes, 67 lichens of Maine; H. B. Parks, *Tetrapanax papyriferum* from horticulture; M. Adrien Questel, 23 fungi, algae, and lichens of Guadeloupe; W. F. Rapp, 21 plants of New Jersey and Illinois; Veli Räsänen, 75 lichens of Finland; H. S. Reed, 2 plants of Pennsylvania; Mrs. H. G. Reh, 51 plants of Greenland; Rocky Mountain Herbarium, 123 plants of Wyoming; C. L. Remington, 12 plants of New Caledonia; B. Rosengurtt, 45 plants of Uruguay;

Robert Runyon, 27 lichens of Texas; P. O. Schallert, 512 plants of western United States; R. W. Schery, 4 photostats of *Cassia oxyphylla* Kunth; R. J. Seibert, 18 plants of Peru; Mrs. Doris Hustis Speirs, *Lobaria pulmonaria* from Ontario; State University of Iowa, 29 fungi from Panama and Colombia; J. W. Thomson, 60 lichens of Wisconsin; W. L. Tolstead, 359 plants chiefly from Pennsylvania and Nevada; U. S. Department of Agriculture, Division of Rubber Plant Investigation, by R. J. Seibert, 190 specimens of *Hevea;* Robert Stratton, 1 plant of Oklahoma; U. S. Arboretum, 14 rubber plants of Brazil; U. S. National Museum, 52 plants of Alaska and 7 specimens of South America; University of Arizona, 264 plants of Arizona; University of California, 200 plants of California and 411 plants of South America; University of Georgia, 16 plants of Georgia; University of Helsingfors, 300 lichens of Finland; University of Michigan, 72 grasses from Mexico; University of Mexico, 15 specimens of *Juniperus* from Mexico; University of Oklahoma, 155 plants of Oklahoma; University of Texas, 159 plants of Texas; Hermann von Schrenk, 4 plants of horticulture; U. T. Waterfall, 223 plants of Texas and New Mexico; West Virginia University, 30 plants of West Virginia; L. Williams, a new orchid from Brazil; Robert Woodson, 4 palms of Panama.

Mounting and Insertion of Specimens: The mounting of herbarium specimens has continued during the year; 10,350 specimens have been mounted. This work has been done effectively by Miss Violet Bauer. Most of this material has been sorted, fumigated, placed in families, and filed in the herbarium; and most of this work has been done by the Curator assisted by Mrs. Nettie Mae Bauer and Mr. Fred Meyer.

The congestion of the herbarium in many places is so acute that further filing is impossible without causing serious damage to the fragile plant specimens. The overflow of new and valuable material is placed in special cartons, sealed, and put in storage. Naphthalene has been used freely to prevent damage by herbarium insects.

Exchange: The exchanges of duplicate herbarium specimens during 1946 have taken a more international aspect than for the past decade. We have received on the basis of exchange 4,146 specimens; and we have sent 2,465 specimens to correspondents.

Use of the Herbarium: The number of visiting botanists who have used the herbarium during the past year is greatly in excess for any one year for the last thirty years. This is due in a large part to the many botanists in attendance at the meeting of the American Association for the Advancement of Science last March. The requests for loan of herbarium material by specialists, who are engaged in monographic, floristic researches and problems of geographical distribution, are increasing from year to year. If the fragile, dried, pressed plants are carefully packed and shipped by express or parcel post it carries with minimum fragmentation. Critical study enhances the scientific value of herbarium specimens. Hence, the loan of such material has been encouraged.

Statistical Summary (For the year ending December 31, 1946):

Number of specimens received during 1946:		
By purchase	5,048	
By gift	1,863	
By exchange	4,146	
By transfer	20	
Total	11,077	
Number of specimens mounted and incorporated in 1946		10,350
Number of specimens carried forward from 1945		1,425,289
Total		1,435,639
Number of specimens discarded during 1946		53
Total number of specimens in Herbarium		1,435,586

LIBRARY AND PUBLICATIONS

The past year has seen a return almost to pre-war conditions in the Garden library. Not only have exchange relations been resumed with foreign countries, but our European subscription agent at the Hague has sent all the European publications which he had purchased for us during the war years. It is a source of gratification that these valuable botanical journals continue from where they left off in 1941, with hardly a number missing. While the number of serial publications received during 1946, by exchange and purchase, does not equal the old-time peak of 1200 annually, it has almost doubled since 1941. Two shipments of ANNALS to 102 foreign institutions were made through the Smithsonian Institution during the year. These consisted of 410 packages containing the volumes issued between 1940 and 1945.

Through the "Friends of the Garden" movement the help that the library can give has been brought to the attention of many local gardeners. On the other hand, the value of the Garden library has long been known to research botanists. Two conventions held in St. Louis in 1946—The Botanical Society of America, and the combined meetings of the American Institute of Park Executives and the American Association of Botanical Gardens and Arboretums—brought visitors by the hundreds. In fact, it was impossible to keep a record of those using the library during the days of the Botanical Society meetings. Many botanists came to St. Louis earlier than the convention, or stayed over, in order to take advantage of the library and herbarium. The greater number of graduate students in the Shaw School of Botany has also brought about an increased use of the library.

Foreign book catalogues, which are the principal sources of obtaining our *desiderata,* are being received in greater numbers. Although they are carefully checked few wanted things seem to be offered. However, it is interesting to note the increase in value of the rare "classics" acquired some years ago, most of which have at least doubled and many have increased more than three times.

With the prospect of a new building as soon as conditions permit, little shifting of books was done, but the basement had become so overcrowded that some time had to be spent rearranging the Department of Agriculture publications there. A survey was also made of the present building (now occupied by offices, herbarium and library) to see how it could be utilized in case it was taken over entirely by the library.

Publications.—Volume XXXIII of the quarterly ANNALS and Volume XXXIV of the monthly BULLETIN were issued during the year. The volume of the ANNALS contains 408 pages, nineteen plates, and 276 text-figures. The February and November numbers were devoted to the Orchidaceae of Panama, by Louis O. Williams, constituting fascicles 2 and 3 of Part III of Woodson and Schery's "Flora of Panama." The BULLETIN contained 260 pages and numerous illustrations. Beginning with September, 1946, all "Friends of the Garden" have been receiving the BULLETIN, since which the issue has more than doubled. An innovation with this volume was the use of colored plates, in this case representing eight varieties of Narcissus, given by the Oregon Bulb Farms to accompany Dr. Anderson's article in the February BULLETIN. Among the BULLETIN articles reprinted in other magazines were: Lindegren's "Breeding Yeasts," in *Chemurgic Digest;* Fairburn's "Plants for Shady Gardens," in *Modern Cemetery;* Fairburn's "Growing Plants Vegetatively," in *Southern Florist and Nurseryman;* Mehlquist's "Ancestors of Our Present-day Cymbidiums" as a supplement to *Bulletin of the American Orchid Society.*

Although additional copies were printed of the April 1945 ANNALS, containing the papers read at the conference on "Gene Action in Microorganisms," the edition is now exhausted. However, as it is still in demand, mostly by foreign institutions, the available reprints were bound with offset reproduction of cover and Discussion pages to make replicas of that number of the ANNALS.

About 540 reprints of ANNALS papers were mailed out during the year to 102 botanists on our exchange list. Many publications are also sold, the receipt for Annals, Bulletins, "Spring Floras," etc. in 1946 being $6,140.57.

Library Accessions.—Probably the most outstanding acquisitions during the year were some lacking volumes of two periodicals: *The Philosophical Transactions of the Royal Society of London*—Ser. B, Vols. 184–230. 1893–1941; and the *American Journal of Science*—missing volumes of old series, and Vols. 1 to date of the current series. Of the Royal Society publications the library had only the abridged volumes of the early *Philosophical Transactions.* The later ones had never been purchased because they could be obtained at several other libraries in St. Louis, but since they contained many botany papers, especially paleobotany, all the available volumes were ordered when seen advertised in a British book catalogue. Our set of *American Journal of Science* was almost complete except for the current series, and last year all the missing parts were purchased. Subscriptions for future volumes of both journals have also been entered.

An interesting bibliographical rarity was Richard Bradley's *A general treatise of husbandry and gardening.* This work is in three volumes, which consists of monthly issues from April 1721 to September 1722. There are other copies in botanical libraries in this country but they all differ from ours in some detail, and whether the copies in the English libraries are duplicates is doubtful. To quote a bibliographical authority: "His [Bradley's] botanical publications show acuteness and diligence, and contain indications of much observation in advance of his time." Another early scientific journal acquired was vol. 1 of the *American Monthly Magazine and Cultural Review* (1817), which contains one of Rafinesque's papers.

Other noteworthy accessions, in addition to current works that one would expect to find in a botanical and horticultural library, were the following: Backeberg, Curt, and Knuth, F. M. Kaktus–ABC—En Haandbog for fagfolk of Amatorer. 1935; Brongniart, A. Histoire des végetaux fossiles. Paris 1828-1837. Facsimile edition, 1915; Cobbett, William. A treatise on Cobbett's corn. 1828; Cox, J. M. A cultural table of orchidaceous plants. 1946; Descole, H. R. Genera et species plantarum Argentinarum . . . Vol. 2, 1946; Duursma, G. D. Succulenten en beeld en woord. 1930; Fuentes y Guzman, F. Recordacion Florida . . . del Reyno de Guatemala. (From 17th century Codex). Vols. 1-3. 1931-33; Hendrichs Perez, P. R. Por tierras ignotas. Viajes y observaciones en la region del Rio de las Balsas. Vol. 2, 1946; Hill, J. Fossils—arranged according to their obvious characters. 1771; Hogben, L. An introduction to mathematical genetics. 1946; Hume, H. H. Camellias in America. 1946; Hutchinson, John. A botanist in southern Africa. 1946; Lange's Flora Agaricina Dansk, Vol. 5, 1939; Müller, O. F. Efterretning og Erfaring om Svampe . . . Pilse. 1763; The Naturalist—A natural history of North England. Vols. 1–13. 1891-99; Niethammer, A. Die

Mikroskopischen Boden-Pilze. 1937; Paucke, F. Hacia alla y para Acá, 1749-1767. Vols. 1–3. Translated by E. Wernicke, 1942-1944; Reprints of Rafinesque's Flora Telluriana and New Flora and Botany of North America. 1946; Squier, E. G. Peru—Incidents of travels and exploration in the Land of the Incas. 1877; Zittel-Schimper's Handbuch der Palaeontologie. 1876.

Several new serials were purchased: The Land; Wrightia; and Boletin de la Sociedad Argentina de Botanica. New institutions on the ANNALS exchange list were: Instituto Botanico de Faculdade de Ciencias de Universidad Lisboa, which sends us Series A and B of its *Acta Biologica;* Instituto de Agricultura Tropical de Universidad de Puerto Rico, which exchanges its *Boletin* for our ANNALS.

Visitors.—The Garden library seems to be used more often by out-of-town research workers. Dr. Whitaker and Dr. Cutler, for instance, both Guggenheim Fellows, spent several months at the Garden. Other visitors who spent several weeks or more in the library were Dr. Ledyard Stebbins and Dr. Carl O. Sauer, of the University of California, Berkeley, and Dr. T. G. Yuncker and Dr. Winona Welch, of DePauw University, Greencastle, Ind. Dr. J. L. Collins, of the Pineapple Research Institute, University of Hawaii, who is studying the origin of the "Cayenne" Pineapple, and Dr. S. L. Fernaroli, of Bergamo, Italy, studying maize, stayed about a week going over the Garden's collection of early natural-history books.

The following list includes the out-of-town visitors to the library during 1946, except those visiting the Garden on the days of the Botanical Society meetings in March: Mr. Charles Gibbs Adams, Landscape Architect, Pasadena, Calif.; Mr. Joseph W. Adams, of the Morris Arboretum, Philadelphia; Miss Josephine Antoine, of University of Iowa, Iowa City; Dr. Fred A. Barkley, of University of Texas, Austin; Mr. Walter D. Bellingrath, of Bellingrath Gardens, Mobile, Ala.; Dr. Lyman Benson, of Pomona College, Claremont, Calif.; Dr. William L. Brown, of Pioneer Hi-Bred Corn Co., Des Moines, Iowa; Dr. Hamilton H. Card, of the Fillmore Community High School, Fillmore, Ill.; Mr. Robert Casamajor, of California Horticultural Institute, Pasadena, Calif.; Dr. J. L. Collins, of the Pineapple Research Institute, University of Hawaii, Honolulu, H. I.; Mr. Gordon C. Cooper, of Cleveland, Ohio; Dr. Hugh C. Cutler, Guggenheim Fellow, Botanical Museum of Harvard University, Cambridge, Mass.; Dr. Carl G. Deuber, of Stauffer Chemical Co., New York; Dr. A. W. Dimock, of Cornell University, Ithaca, N. Y.; Dr. Ethel Eltinge, of Mt. Holyoke College, South Hadley, Mass.; Dr. Carl C. Epling, of University of California, Los Angeles, Calif.; Dr. Ralph O. Erickson, of University of Rochester, Rochester, N. Y.; Mr. Robert Evers, of University of Illinois, Urbana; Dr. Norman Fassett, of University of Wisconsin, Madison; Mr. C. W. Fenninger, of Tyler Arboretum, Philadelphia; Prof. S. Luigi Fernaroli, Director Stazione Sperimentale de Maisocultura, Bergamo, Italy; Dr. Ruth M. Foster, of University of Texas, Austin; Dr. Harry J. Fuller, of University of Illinois, Urbana; Prof. Roger Gautheret, of the Faculté des Sciences, Nogent s. Marne (Seine), France; Dr. Joseph C. Gilman, of Iowa State College, Ames; Mr. Clarence Godshalk, of Morton Arboretum, Lisle, Ill.; Dr. George J. Goodman, of University of Oklahoma, Norman; Dr. George B. Happ, of Principia College, Elsah, Ill.; Mrs. Gretchen Harshbarger, Garden Editor, *The Household;* Dr. Ada Hayden, of Iowa State College, Ames; Dr. Alexander Hollaender, of National Institute of Health, Bethesda, Md.; Mr. Niels Jacobsen, Carnation Grower, Aabenrau, Denmark; Dr. James A. Jenkins, of University of California, Berkeley; Dr. George Thomas Johnson, of Massachusetts Institute of Technology, Boston; Mr. Raymond E. Johnson, of the Minnesota Department of Conservation, St. Paul; Mr. E. L. Kammerer, of Morton Arboretum, Lisle, Ill.; Mr. George Kelly, of Littleton, Colorado, Editor of *Green Thumb;* Dr. Maxine Larisey, of Judson College, Marion, Alabama; Dr. Pierre Larroque, of Institut des Recherches Agronomiques de l' Indochine; Dr. Samuel G. Lehman, of North Carolina State College, Raleigh; Dr. Catharine M. Lieneman, of Wisconsin State Teachers' College, River Falls; Mr. Lyman, of Hilo, Hawaiian Islands; Prof. Howard E. McMinn, of Mills College, Oakland, Calif.; Dr. Frank P. McWhorter, of Oregon Agricultural Experiment Station, Corvallis; Prof. A. D. Moore, of University of Michigan, Ann Arbor; Mr. B. Y. Morrison, of U. S. National Arboretum, Washington, D. C.; Mr. Paul Mose, Rose Grower, Glamsbgerg, Tyn, Denmark; Dr. A. C. Murneek, of University of Missouri, Columbia; Mrs. Iva Newman, of San Mateo, Calif., Garden Editor *Peninsula Life;* Mr. Roy M. Nordine, of Morton Arboretum, Lisle, Ill.; Dr. Marion Ownbey, of Washington State College, Pullman; Dr. E. F. Paddock, of Ohio State University, Columbus; Mr. Hotbar Pauldan, of the Royal Veterinary and Agricultural Highschool, Copenhagen, Denmark; Father Dromede Pohlkamp, of St. Anthony Hospital, Louisville, Ky.; Mr. Robert Pyle, of Conard & Pyle, West Grove, Pa.; Dr. Carl O. Sauer, of University of California, Berkeley; Mr. Richard D. Schein, of DePauw University, Greencastle, Ind.; Dr. Jacob R. Schramm, of University of Pennsylvania, Philadelphia; Dr. H. A. Senn, of Dominion Arboretum, Ottawa, Canada; Mr. Lloyd L. Smith, of Bureau of Fisheries, Minnesota Department of Conservation, St. Paul; Mr. Walter K. Smith, of Bellingrath Gardens, Mobile, Ala.; Mr. Richard Spears, of University of Louisiana, Baton Rouge; Dr. E. R. Spencer, Consulting Soil Botanist and Plant Pathologist, Lebanon, Ill.; Dr. Ledyard Stebbins, of University of California, Berkeley; Dr. Julian A. Steyermark, of Chicago Museum of

Natural History; Mr. Henry Teuscher, of Montreal Botanic Garden, Canada; Dr. T. H. Van Eck, of the General Experiment Station, Buitenzorg, Java; Dr. J. Van Overbeck, of Institute of Tropical Agriculture, Mayaguez, Porto Rica; Dr. Winona Welch, of DePauw University, Greencastle, Ind.; Dr. Louis O. Williams, of Escuela Agricola Panamericana, Tegucigalpa, Honduras, C. A.; Mr. Harold F. Winters, of the Federal Experiment Station, Mayaguez, Porto Rica; Mr. Harry Wood, of the Arthur Hoyt Scott Foundation, Swarthmore College, Swarthmore, Pa.; Mr. Richardson Wright, of New York, Editor *House and Garden;* Mr. C. A. Wychoff, of University of Oklahoma, Norman; Dr. Donald Wyman, of Arnold Arboretum, Jamaica Plain, Mass.; Dr. T. G. Yuncker, of DePauw University, Greencastle, Ind.

During the year the library loaned 141 books to 26 institutions on the interlibrary loan plan.

Statistical Information.—There have been donated to the library or received in exchange during the year 530 books valued at $1,273.63, 1,424 pamphlets valued at $314.75, and 1 manuscript valued at $5.00. There were 412 books bought at a cost of $2,857.31, 110 pamphlets at a cost of $81.18, and 4 maps at a cost of $4.50. The library now contains 57,317 books, 98,147 pamphlets, and 356 manuscripts. The number of index cards now totals 1,109,289, of which 7,982 were added during the year, 1,222 having been written by Garden employees and 6,760 purchased at a cost of $154.79. One hundred and twenty-two books were bound.

ANNUAL BEQUESTS

The annual flower sermon "On the goodness of God as shown in the growth of flowers, fruits, and other products of the vegetable kingdom," provided for in the will of Henry Shaw, was preached at Christ Church Cathedral on May 12, by Dr. Henry Sloane Coffin, for many years president of the Union Theological Seminary, New York.

The gardeners' banquet fund was used to provide turkeys for employees at Christmas.

ATTENDANCE FOR 1946

(Not including visitors to Arboretum)

	Week-days	*Sundays*
January	3,461	4,862
February	4,840	8,186
March	7,525	12,874
April	11,778	15,354
May	12,735	12,456
June	15,523	6,661
July	15,062	6,715
August	14,942	9,267
September	16,045	28,346
October	10,472	10,753
November	16,114	21,078
December	3,909	4,943
	132,406	141,495
		132,406
Total		273,901

Respectfully submitted,
George T. Moore, *Director.*

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

THE MISSOURI BOTANICAL GARDEN

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MISSOURI BOTANICAL GARDEN BULLETIN

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Cover: *Vanda tricolor* growing on the trunk of a Chinese Fan Palm in the Palm House. Specimen from the collection presented to the Garden by D. S. Brown in 1918.

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Please: Do not discard a copy of the Bulletin. If you have no further use for yours pass it along to a friend or return it to the Garden. Return postage will be guaranteed.

Missouri Botanical
Garden Bulletin

Vol. XXXV FEBRUARY, 1947 No. 2

THE MAGNOLIAS

ROBERT B. CLARK

No other large shrubs are so spectacular in early spring as the Magnolias of Eastern Asia, and the showiest of these is the delicate Star Magnolia (*Magnolia stellata* Maxim.). Its petals are like narrow bands of white ribbon tied in a bow on the naked gray branches, and its delightful fragrance fills the air. Here at the Garden three specimens are growing in the center of the Knolls where they may be seen from several aspects.

Appearing at about the same time as the Star Magnolia is the familiar Saucer Magnolia (*M. Soulangeana* Soul.), whose huge pink-flushed petals unfold as a deep cup and are soon followed by the leaves. This plant is a hybrid between *M. denudata* and *M. liliflora*, two Asiatic species less frequently planted. The original cross was made previous to 1826 in the garden of the Chevalier Soulange-Bodin, for whom it was named. There are a number of "varieties" of the Saucer Magnolia in cultivation. The Lenné Magnolia (var. *Lennei* Rehd.), which resembles the male parent rather closely, is often planted. This variety has deep maroon or purplish flowers whose petals never seem to unfold completely but remain erect until they drop off. Like *M. liliflora*, it blooms a week to ten days later than the Saucer Magnolia. Other forms of the Saucer Magnolia include the whites or near whites, vars. *alba* and *spectabilis*, and the whites tinged with purple toward the base, vars. *Alexandrina, Brozzonii, Candolleana, speciosa,* etc. All these varieties differ from each other only in minor respects and are interesting chiefly to the collector.

The remaining species of Magnolia are of American origin; they bloom after the leaves have unfolded and, therefore, are not so conspicuous in flower as the Oriental ones. First of this group to bloom is the Cucumber-tree (*Magnolia acuminata* L.) which reaches a height of 60 feet and, like its cousin, the Tulip-tree, bears greenish flowers unnoticed except to the trained eye. Next is the Umbrella Magnolia (*M. tripetala* L.) whose showy large flowers are borne in a rosette of huge leaves and give off an odor considered by many as not particularly pleasant.

The summer-blooming Magnolias are the Bull and Sweet Bays. The former (*M. grandiflora* L.) is somewhat tender in the latitude of St. Louis. However, when it does succeed in flowering it attracts much attention because of its creamy white, fragrant flowers whose petals form a deep bowl. The glossy, leathery, evergreen foliage is very coarse, and the plant, which rarely is more than a large shrub in this region, requires a large garden (and winter shelter) to be displayed to best advantage. The Sweet Bay (*M. virginiana* L.) is a large arching shrub that reaches no more than 20 feet in height at the Garden. It bears the smallest flowers of the group but they appear during the hot days of summer when few other trees are in bloom. However, special consideration must be taken in the selection of site so that its pale, gray-green foliage does not "clash" with that of adjacent plants.

Star Magnolia *(Magnolia stellata)*

No other family of hardy woody plants has such large, simple leaves nor such huge flowers. The blooms are generally conspicuous and in the late summer and early fall the orange-red fruits exhibit interesting patterns of color until the squirrels find them. The Asiatic species flower in early

Saucer Magnolia *(Magnolia Soulangeana)*

spring before the leaves unfold, while flowers of the native American kinds do not appear until after the leaves have expanded. Relatively free of insect pests and disease, the Magnolias are easy to cultivate. According to E. H. Wilson, formerly Keeper of the Arnold Arboretum, "All Magnolias grow naturally in moist, rich woods and they detest drought. They will withstand considerable hardship and abuse, but the best results are obtained when they are protected from strong winds and are planted in cool, deep soil, rich in humus. An ideal place is open, moist woods. In northern gardens the best time to transplant Magnolias is late in the spring. They may also be moved successfully in late August, but at either season they must not be allowed to suffer from lack of water, and it is advisable to mulch them with well-decayed manure. These are practical items of the highest importance which no aspirant to success can afford to neglect. Moreover, such magnificent garden plants are worthy of a little extra attention and repay it a hundredfold."

GLOXINIAS—PAST AND PRESENT

DENNISON MOREY

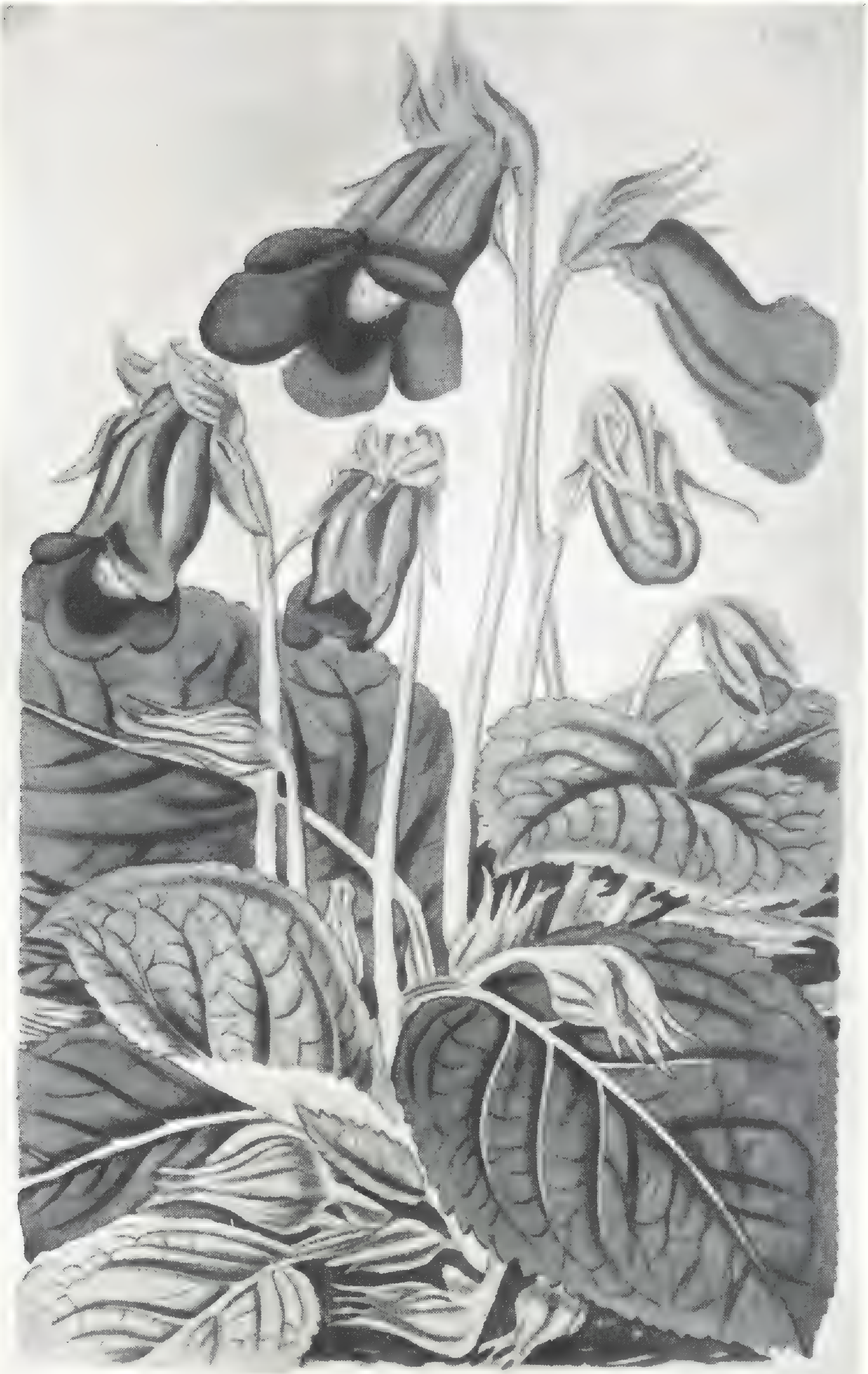
Because the garden Gloxinia seems to me to be the most glamorous of all our warm-blooded plants I became intrigued with it and have tried to discover the story of its evolution from a tropical jungle weed to the exotic thing that it is today.

The earliest recorded progenitors of the garden Gloxinia were introduced from Brazil into England about 1815, and some acquired a considerable measure of popularity. The original plants apparently were of but two colors, purple and white. They were readily crossed and variations of the two colors appeared in abundance. A little later light pinks became common, but even the best of these were rather sorry things compared to the plants that we are accustomed to see today. Even so, the Gloxinia was immensely popular in England and was figured in several botanical magazines of the time, the best illustrations being in the *Botanical Magazine* in 1817.

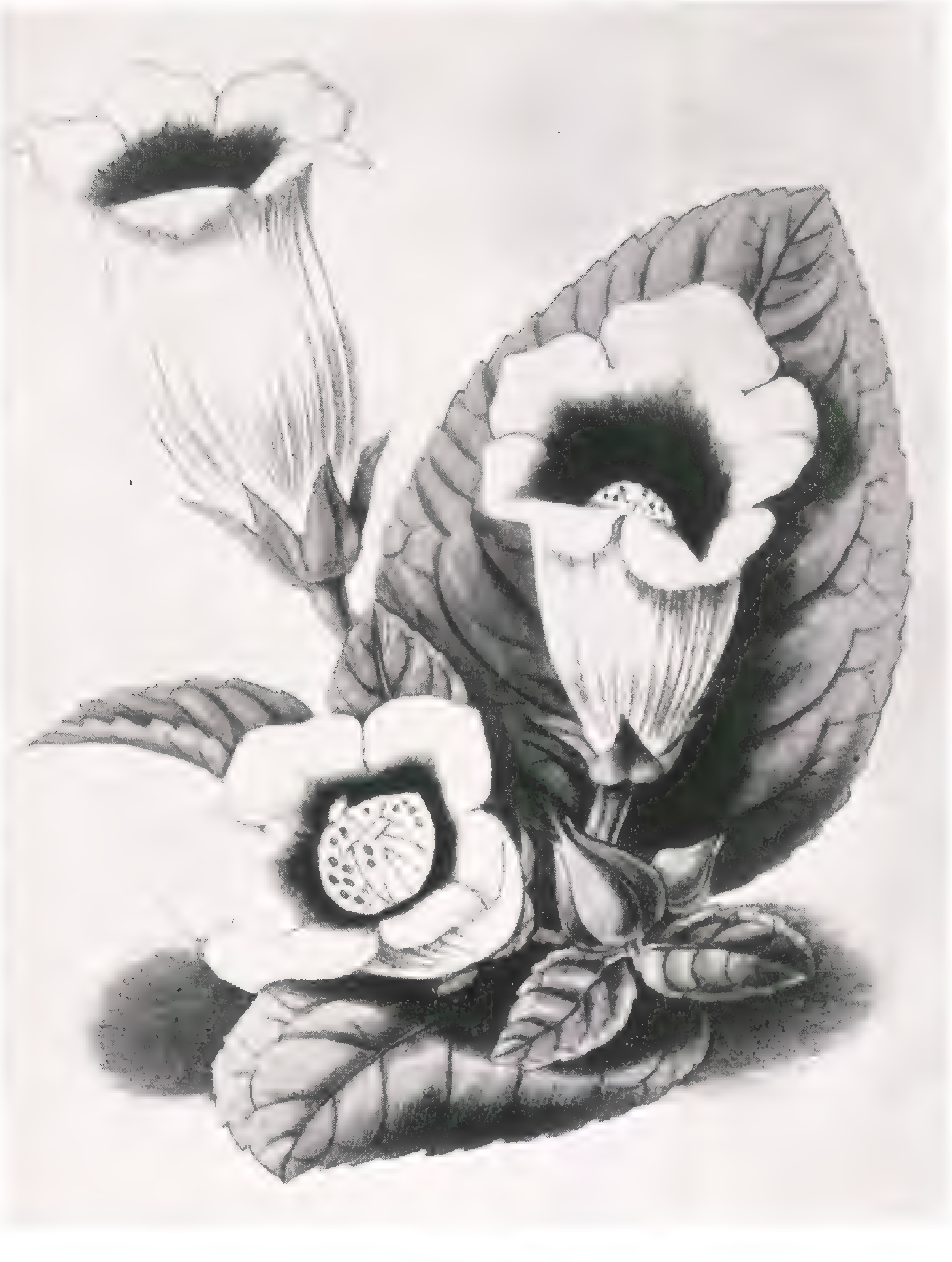
Subsequent importation of the corms from Brazil introduced into the floricultural scene a number of new species including *Gloxinia caulescens, G. crassifolia,* and *G. speciosa,* with its three varieties, all of which stand out in the cultural evolution of Gloxinia. These varieties are *rubra* (the red-flowered), *albiflora* (the white-flowered), and *macrophylla* (the large-leaved). In crosses subsequently made, probably between *G. speciosa* and *G. caulescens,* the erect-flowered *G. erecta* and the brightly spotted *G. punctata* were produced.

In order to understand better the origin of our modern varieties with their huge colorful blossoms—and lots of them on each plant—a few details concerning the plants more than a century ago may be in order.

Gloxinia speciosa differed from modern plants in that the leaves were narrower, and that the flowers were fewer, smaller, of more drab color, and tended to be drooping. The plant was virtually stemless, as is the modern plant, and produced its flowers singly on long stems. *G. caulescens,* however, had a stem sometimes more than a foot long with the leaves aggregated at



Gloxinia speciosa
(From *pl. 1937* of *Curtis's Botanical Magazine.* 1817)



Gloxinia Fyfiana
(From *pl. 3* of *Floricultural Cabinet.* 1847)

the crown. Moreover, the more erect flowers were in the leaf axils, and had faint but obvious freckles. The third species, *G. crassifolia*, was distinguished by its broad firm leaves and over-all luxurious habit of growth. Also, while *G. speciosa* was often splotched and uneven in color, *G. crassifolia* had fine solid colors without spots. All the other types had a funnel-shaped corolla tending to be narrow, but the corolla of *G. crassifolia* had the alluring campanulate shape that we so much admire in the Gloxinia today. Thus it may be seen that there were many desirable characters scattered through these three species, and it was the job of the plant breeder to remold them into the desired combinations.

In describing the steps that led up to the Gloxinia of today we may consider them in phases: the development of bright colors and color patterns, the erect flower habit, and the increase in the beauty of the plant by the improvement of its leaf size and flower shape. Even though the early growers had only blue, white, and a little pink to work with they made some improvement, chiefly in achieving various combinations of blue and white. A real mark of progress, however, appeared in 1840, when Mr. Young, a well-known gardener in Epsom, England, obtained some corms from a Mr. Buist of Philadelphia. Mr. Buist, who apparently was only an importer, had procured them in turn from Brazil. When Mr. Young flowered his newly acquired corms he discovered that he was the possessor of a magnificent dark red Gloxinia verging upon scarlet. To the Gloxinia fanciers of the time who had known of nothing but a purple, white, and pale pink flower for twenty-five years, this red-flowered plant was a sensation, and it was not long before many new and far prettier plants were on the market and being exhibited in the flower shows.

The highest development of color was accomplished by the efforts of Van Houtte, the famous Belgian horticulturist, who, by 1865, succeeded in producing and offering for sale over 150 different Gloxinias. To realize the extent of his work one need but look through the *Flore des Serres*, vols. 3–20, where most of his more spectacular creations are illustrated in color. He reached a peak with the Gloxinia he called "Mina," after his wife. Its flower had a white lip with a bright carmine throat and is still the most striking of all Gloxinia flowers, but unfortunately all of Van Houtte's plants had drooping flowers. At the same time another type of flower was being developed by Vallerand, a well-known French grower of the 19th century. He dedicated his efforts to the perfection of the spotted Gloxinia and by 1875 he had brought this type to a point that has never been equalled. Though the improvement of color by no means ceased with nor can be wholly attributed to Van Houtte and Vallerand, they brought the color and color pattern groundwork to such a point that it left only the possibility of refinements to their successors. However, all these plants still retained the drooping flower habit, and since a great portion of the color of the Gloxinia is located on the inside of the corolla it could not be seen to advantage. It is not unexpected, therefore, to learn that the growers heartily welcomed the arrival of *Gloxinia erecta*. Its ancestors are not certain, the plant having been obtained in 1845 from a cross between some white and purple-spotted plants in the collection of John Fyfe of Rothesay. It was soon discovered that the erect habit was a dominant characteristic, and crosses with the bright-colored strains produced another sensation in the Gloxinia world.

In France, in 1860, the able horticulturist Rossiaud introduced *G. crassifolia*. It seems likely that this was a new species which he obtained direct from Brazil and improved prior to its entrance upon the market. These plants were very beautiful even though their colors were pale. They had immense velvety leaves, large plump flowers with broad deep corollas, and a very strong habit. Upon giving it Fyfe's erect flowers and Van Houtte's magnificent colors there was the Gloxinia of your window-sill except for a few oddities that had appeared in the course of careful selection for new types.

Sports occur in many plants and if they are selected and bred, a new type may be developed. It may well be that Fyfe's *G. erecta* was such a sport; if so, it was a lucky catch. Usually sports of cultivated flowers are evidenced outwardly by such things as double flowers and extra flower parts and variegated foliage. The Gloxinia did not escape having its wayward deviations capitalized upon. Ordinarily, the flowers have five stamens and five corolla segments, but in 1868 Van Houtte introduced plants with six (later seven) of these organs. This condition made larger flowers and was encouraged, so that today it is difficult to find good plants with less than six corolla segments. But that is not all—in 1873 Van Houtte thought that he had something really exceptional when he was able to present the world with the double Gloxinia. This double type was not pretty but it was unusual and every one had to have it. The doubleness was due to the fact that the sepals had become petals. Remnants of this habit can be found in almost any Gloxinia population, one or two sepals on the flowers of some plants having become petaloid in texture and color. Nonetheless, it is now uncommon in entirety because it was far from being an attractive thing.

Recently, in our own Gloxinias, we found flowers with petaloid stamens. It seems possible that the history of the Gloxinia has not ceased to be a vital thing. In general, though, it seems quite likely that the better selections have been made and that the Gloxinia of today is pretty much as it always will be—the most striking and beautiful of all warm-house plants and an exceedingly pleasant experience for the person who knows and grows them.

A SELECTION OF SHRUBS FOR ST. LOUIS AND VICINITY*

ROBERT B. CLARK

Structurally, shrubs "make" a garden because they define areas by means of their mass effects from the ground to and above the level of the eye. There are shrubs for spectacular color displays (in foliage, flower and fruit), for screening, and for fragrance. Deciduous shrubs are attractive throughout the several seasons: in spring usually for their masses of flowers, in summer for foliage, in autumn for fruits, and in winter barrenness for twig patterns. The broad-leaved evergreen shrubs, on the other hand, present rather constant aspects throughout the year.

Van Houtte's Spirea *(Spiraea Vanhouttei)*

Shrubs may be recognized as plants having several woody stems which seldom exceed twenty feet in height. In contrast, trees have single stems or trunks, and are usually taller. There is an interesting group of semi-shrubs mentioned by Professor Rehder as "plants of which only the lower part of the stems and branches persists and becomes woody, while the upper part dies back annually, or which have stems persisting for several years without becoming truly ligneous." Examples of this group are the hardy bamboos, butterfly-bushes and the chaste-tree.

While trees require many years before reaching maturity, shrubs attain useful sizes and begin to bloom and bear fruit within a few years. Moreover, given proper care they remain presentable for decades. And yet to grow shrubs well it is not necessary to fuss with them. Most shrubs prefer a circumneutral to slightly acid soil (except ericaceous plants like rhododendrons, which demand a medium to strongly acid soil), a light or partial shade, and judicious pruning every year or so. In planting shrubs healthy plants are imperative, and smaller plants are usually preferable to larger ones. Select a well-drained situation and prepare the soid by generous application of stable manure, or, if that is not available, a complete commercial fertilizer. Keep the soil moist but not puddled. A mulch of dried leaves (any kind but oak) or straw will provide adequate moisture and discourage weeds.

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* The present article is a sequel to "A Selection of Trees for St. Louis and Vicinity," that appeared in the November 1946 BULLETIN.

Weigela floribunda

The following lists are made up of tested shrubs for the St. Louis area. No attempt has been made to include all the shrubby plants that may be grown in this region; in fact, only a few bush roses, one mock-orange, one cotoneaster, and a few spireas, honeysuckles and viburnums are given. Reference has already been made to those plants which usually die back nearly to the ground each year. There are many plants whose branch tips sometimes or regularly are affected by winter temperatures. These include the beauty-berries, bush-clovers, false-spireas, groundsel-bush, Snowhill Hydrangea, Japanese Kerria, Securinega, tamarisks and the Desert Willow. Other species which are unreliable and die back occasionally, according to the severity of the winter, are the Laland Firethorn and the California Privet.

The lists give important data for comparing one plant with another. The first column deals with the texture of the foliage: coarse (C), medium (M), or fine (F). Several factors contribute to the texture. If the leaves are large with smooth margins and a glossy top surface, the texture is coarse. Conversely, when the leaves are small, pinnately divided or saw-toothed and the surfaces are dull, their texture is fine. A mixing of these characters is likely to produce a medium-textured foliage. The second column refers to the color of the flowers; inconspicuous flowers are represented by a dash. The third column lists the time of blooming. The fourth column gives the color of the fruit, and again, if inconspicuous, a dash is used. The fifth column deals with the soil reaction, if established*. The sixth column records the preference of plants to sun or partial shade (X).

Ural False-spirea *(Sorbaria sorbifolia)*

Shrubs are useful in the landscape according to their ultimate heights. Excluding ground covers, prostrate and other low-growing shrubs, they may be separated arbitrarily into the following classes: 2–3 ft., 3–4 ft., 4–6 ft., 6–8 ft., 8–12 ft., and 12–20 ft. In the first group are plants for foreground of shrubberies, edging material, background for rockeries, and a variety of other situations. They are rather small and will adapt themselves nicely to limited spaces in the garden area.

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* Spurway, C. H., Soil reaction (pH) preferences of plants, Mich. Agr. Exp. Sta. Spec. Bull. 306. 1941.

Elderberry (*Sambucus canadensis*)

There is a wider selection of shrubs in the 3–4-foot category. If they have sufficiently attractive mass and texture of color throughout the seasons, they may be used for accent; otherwise they become "fillers" the primary value of which is "filling" voids between outstanding shrubs, and the secondary purpose is supplying one attractive aspect during any given season. The Five-leaf Aralia and the barberries are thorny, an important or valuable character for low-growing hedges.

SHRUBS 2–3 FEET TALL

Botanical Name	Common Name	Texture	Fl. color	Season	Fr. color	pH*	Shade
Berberis Julianae	Wintergreen Barberry	C	yellow	Ap	black	neutral	X
Berberis Thunbergii minor	Box Barberry	F	yellow	Ap	red	neutral	X
Deutzia gracilis	Slender Deutzia	M	white	Ap–My	—	6.0–7.5	Sun
Genista tinctoria	Woodwaxen	F	yellow	Je–Aug	—	indif	Sun
Hydrangea arborescens grandiflora	Snowhill Hydrangea	C	white	My–Jy	—	6.0–8.0	X
Lonicera syringantha Wolfii	Wolf's Lilac Honeysuckle	F	red	Ap	red	indif	X
Pseudosasa japonica	Metake (Bamboo)	C	—	—	—	—	X
Pieris japonica	Japanese Andromeda	M	white	Ap	—	5.0–6.0	X
Rhododendron obtusum amoenum	Amoena Azalea	F	red	Ap–My	—	4.5–6.0	X
Rhododendron yedoense poukhanense	Korean Yodogawa Azalea	M	blue	Ap	—	subacid	X
Rosa carolina	Pasture Rose	M	pink	Ap–My	red	—	Sun
Spiraea arguta	Garland Spirea	F	white	Ap–My	—	neutral	X
Spiraea Bumalda	Bumalda Spirea	M	pink	My–Je	—	6.0–7.0	X
Symphoricarpos orbiculatus	Snow-berry	F	—	Aug	white	5.5–7.5	X
Smyphoricarpos racemosus	Coral-berry	F	—	Aug	red	neutral	X

SHRUBS 3–4 FEET TALL

Botanical Name	Common Name	Texture	Fl. color	Season	Fr. color	pH*	Shade
Abelia grandiflora	Glossy Abelia	F	white	Je–N	—	5.0–8.0	X
Acanthopanax Sieboldianus	Five-leaf Aralia	M	—	Je	—	neutral	X
Aronia arbutifolia	Red Chokeberry	M	white	Ap	red	5.0–6.0	X
Berberis mentorensis	Mentor Barberry	M	yellow	Ap	red	neutral	X
Berberis Thunbergii atropurpurea	Purple-leaf Barberry	M	yellow	Ap	red	neutral	X
Calycanthus floridus	Strawberry-bush	C	red	Ap–Jy	—	6.0–7.0	X
Forsythia ovata	Early Forsythia	C	yellow	Mr–Ap	—	indiff	X
Forsythia suspensa Fortunei	Fortune Forsythia	F	yellow	Mr–Ap	—	5.0–6.5	X
Ilex crenata convexa	Box Holly	M	—	Je	black	5.0–6.5	Sun
Kerria japonica plena	Japanese Kerria	M	yellow	Ap–S	—	6.0–7.0	X
Mahonia Aquifolium	Oregon Holly grape	C	yellow	Ap	black	—	X
Rhododendron japonicum	Japanese Azalea	M	red	Ap	—	subacid	X
Rhododendron mucronatum	Snow Azalea	M	white	Ap–My	—	subacid	X
Rhododendron roseum	Roseshell Azalea	M	pink	Ap–My	—	subacid	X
Rhodotypos scandens	Jetbead	M	white	Ap, S	black	6.0–7.5	X
Rosa palustris	Swamp Rose	M	pink	Je–Au	—	6.0–8.0	Sun
Rosa rugosa	Rugosa Rose	M	pink	Ap–My, S	red	—	Sun
Securinega suffruticosa	Securinega	F	white	Je	—	—	X
Spiraea prunifolia plena	Bridalwreath	F	white	Ap	—	neutral	X

* The figures in this column represent the soil reaction best suited to the plant; for example, pH 7.0 is neutral; 6.5–6.9 is slightly acid; 5.3–6.4, medium acid; 4.5–5.2, strongly acid; 7.1–7.5, slightly alkaline; 7.6–8.2, medium alkaline. When the exact soil preference is not established it is expressed as neutral, indiff, or by a dash.

Shrubs 4–6 feet in height reach the normal level of the eye. This group and succeeding ones contribute appreciably in forming living walls of gardens and in enclosing areas. Like those plants of the preceding group, certain species find use as "fillers" or as "accents," depending upon their mass, texture and color.

SHRUBS 4–6 FEET TALL

Botanical Name	Common Name	Texture	Fl. color	Season	Fr. color	pH	Shade
Buddleia alternifolia	Fountain Butterfly-bush	F	blue	My	—	—	Sun
Buddleia Davidii	Orange-eye Butterfly-bush	M	blue	Je–O	—	6.0–7.5	Sun
Callicarpa purpurea	Beauty-berry	C	white	Jy	purple	—	X
Cercis chinensis	Chinese Redbud	C	red	Ap	—	—	X
Chaenomeles lagenaria	Flowering Quince	C	red	Ap	—	6.0–7.0	Sun
Deutzia scabra	Rough Deutzia	M	white	My–Je	—	—	Sun
Elaeagnus multiflora	Cherry Elaeagnus	M	yellow	Ap–My	red	—	Sun
Euonymus kiautschovica	Spreading Euonymus	C	green	Je	red	—	X
Ilex glabra	Inkberry	M	—	My	black	4.5–5.0	X
Lonicera Morrowi	Morrow Honeysuckle	F	white	Ap–My	red	—	X
Malus Sargentii	Sargent Crab-apple	M	white	Ap	red	—	Sun
Philadelphus virginalis "Virginal"	Virginal Mockorange	M	white	My	—	neutral	X
Prunus tomentosa	Nanking Cherry	M	white	Mr–Ap	red	—	Sun
Pyracantha coccinea Lalandi	Laland Firethorn	M	white	Ap–My	red	6.0–8.0	Sun
Rhododendron catawbiense	Catawba Rhododendron	C	red	My	—	subacid	X
Rhododendron nudiflorum	Pinxterbloom	M	pink	Ap–My	—	subacid	X
Rosa Hugonis	Father Hugo's Rose	F	yellow	Ap–My	red	—	Sun
Spiraea Vanhouttei	Van Houtte Spirea	M	white	My	—	6.0–7.0	Sun
Viburnum Carlesi	Fragrant Viburnum	C	white	Ap	black	—	Sun
Weigela floribunda	Crimson Weigela	C	red	Ap–My	—	—	Sun
Wisteria frutescens	Shrubby Wisteria	M	purple	My	—	—	X

Those shrubs whose ultimate height exceeds the level of the eye are excellent for background material. Characters to look for in selecting such plants are dense foliage and, if a formal screen is desired, their capacity to retain lower branches. Shrubs that are dependable for screen planting are the Glossy Cotoneaster, Winged Euonymus, Goldenbells (Forsythia), Beautybush, privets, Spicebush, Star Magnolia, Fragrant Sumac, lilacs and the viburnums.

SHRUBS 6–8 FEET TALL

Botanical Name	Common Name	Texture	Fl. color	Season	Fr. color	pH[1]	Shade
Aesculus parviflora	Dwarf Horse-chestnut	C	white	Je	—	—	X
Chilopsis linearis	Desert Willow	F	white	Je–Aug	—	—	Sun
Cornus stolonifera	Yellow Osier Dogwood	C	white	My	white	6.0–7.0	Sun
Cotoneaster foveolata	Glossy Cotoneaster	C	pink	My	black	—	Sun
Elaeagnus argentea	Silverberry	M	yellow	Je	silvery	6.0–7.0	X
Euonymus alata	Winged Euonymus	M	yellow	Ap	purple	6.0–7.5	X
Forsythia intermedia spectabilis	Showy Border Forsythia	C	yellow	Mr–Ap	—	6.0–7.5	X
Grewia biloba parviflora	Grewia	C	white	Ap	red	—	X
Hibiscus syriacus	Shrub Althea	C	various	Je–S	—	6.0–7.5	Sun
Hydrangea paniculata praecox	Early Panicle Hydrangea	C	white	Je–Jy	—	—	Sun
Kolkwitzia amabilis	Beautybush	F	pink	My	—	6.0–7.5	Sun
Lespedeza bicolor	Purple Bush-clover	F	white	S	—	—	X
Ligustrum amurensis	Amur Privet	M	white	My–Je	black	indiff	X
Ligustrum ibolium	Ibolium Privet	M	white	My–Je	black	indiff	X
Ligustrum obtusifolium Regelianum	Regel's Privet	M	white	My–Je	black	indiff	X
Ligustrum ovalifolium	California Privet	M	—	—	—	indiff	Sun
Ligustrum Quihou	Quihou Privet	M	white	Aug–S	black	indiff	Sun
Lindera Benzoin	Spicebush	M	yellow	Mr–Ap	red	4.5–6.0	X
Lonicera fragrantissima	Fragrant Honeysuckle	C	white	Mr–Ap	—	indiff	X
Magnolia stellata	Star Magnolia	C	white	Mr–Ap	—	5.0–6.0	Sun
Phyllostachys aureosulcatus	Hardy Bamboo	M	—	—	—	—	X
Rhus aromatica	Fragrant Sumac	F	yellow	Mr–Ap	red	—	X
Rosa setigera	Prairie Rose	M	pink	My–Aug	red	—	Sun
Sambucus canadensis	Elderberry	C	white	My–Je	black	—	X
Sorbaria sorbifolia	Ural False-spirea	M	white	Je–Jy	—	indiff	X
Syringa Henryi "Lueèce"	Henry Lilac	C	lilac	My	—	neutral	Sun
Syringa microphylla	Little-leaf Lilac	F	pink	Ap–My	—	neutral	Sun
Syringa nanceana "Floréal"	Nancy Lilac	C	lilac	My	—	neutral	Sun
Syringa villosa	Late Lilac	C	lilac	My	—	neutral	Sun
Viburnum Lantana	Wayfaring-tree	C	white	Ap–My	black	5.5–7.0	X
Viburnum Opulus	European Cranberry	M	white	My	red	6.5–7.5	X
Viburnum tomentosum	Doublefile Viburnum	C	white	Ap–My	black	6.5–7.5	X
Vitex Agnus-castus	Lilac Chaste-tree	M	lilac	Je–S	—	6.0–7.0	Sun
Xanthoceras sorbifolia	Shiny-leaf Yellowhorn	M	white	Ap–My	—	—	Sun

Shrubs for tall screens and for large mass effects are found in the following group. These plants are on such large scale that it usually requires parks and large estates to display them properly. The average gardener would do well to use them in moderation or as single specimens.

SHRUBS 8–12 FEET TALL

Botanical Name	Common Name	Texture	Fl. color	Season	Fr. color	pH	Shade
Albizzia Julibrissin rosea	Hardy Silk-tree	F	pink	Je–Au	—	—	Sun
Amelanchier canadensis	Shadbush	M	white	Ap	purple	5.0–6.0	X
Baccharis halimifolia	Groundsel-bush	F	white	S–O	white	7.0–8.0	Sun
Caragana arborescens	Siberian Pea-tree	F	yellow	Ap	—	6.0–7.0	Sun
Chionanthus virginicus	White Fringe-tree	C	white	My	blue	5.0–6.0	Sun
Cornus mas	Cornelian Cherry	M	yellow	Mr	red	6.0–8.0	X
Euonymus atropurpurea	Eastern Burningbush	C	purple	My	red	—	X
Exochorda Giraldii Wilsonii	Wilson Redbud Pearlbush	C	white	Ap–My	—	neutral	Sun
Hamamelis vernalis	Vernal Witch-hazel	C	yellow	Ja–F	—	undiff	X
Hamamelis virginiana	Common Witch-hazel	C	yellow	O–N	—	6.0–7.0	X
Prunus cerasifera atropurpurea	Purple-leaf Plum	M	pink	Mr–Ap	red	—	Sun
Rhamnus Frangula	Alder Buckthorn	C	yellow	My	black		X
Shepherdia argentea	Buffalo-berry	M	yellow	Ap–My	red	6.0–8.0	X
Syringa amurensis japonica	Japanese Tree Lilac	C	white	My–Je	—	neutral	Sun
Tamarix gallica	French Tamarisk	F	pink	Ap–My	—	subacid	Sun
Viburnum prunifolium	Black Haw	C	white	My	black	—	X

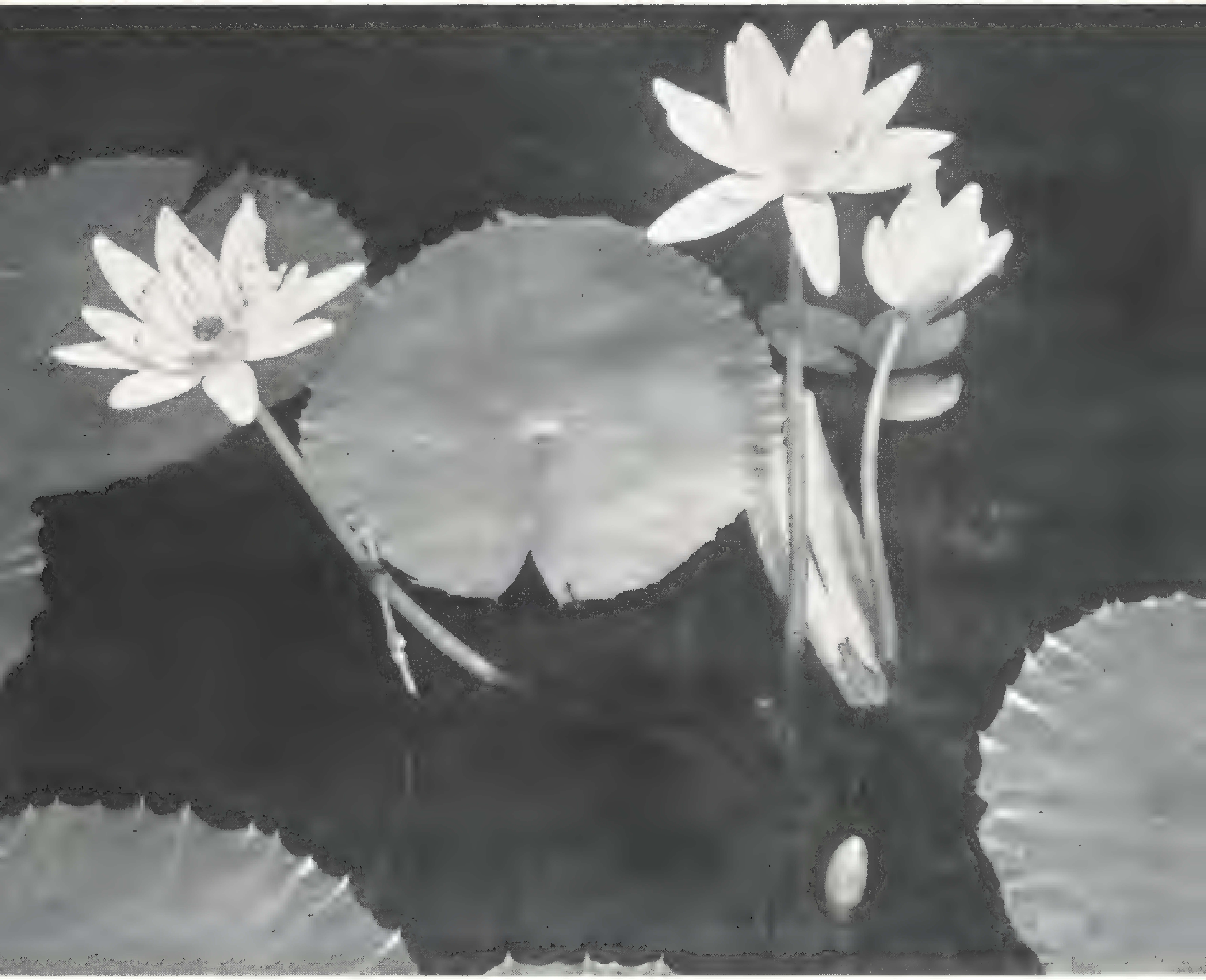
Tallest of shrubs are those that reach 12–20 feet in height and are usually, though loosely, referred to as small trees. In spite of the appealing characters of these plants care should be taken that too many are not used in a small place and that only those best suited to such an area be chosen.

SHRUBS 12–20 FEET TALL

Botanical Name	Common Name	Texture	Fl. color	Season	Fr. color	pH	Shade
Cyrilla racemiflora	Leatherwood	M	white	Je–Jy	—	6.0–8.0	Sun
Elaeagnus angustifolia	Russian Olive	F	yellow	My	yellow	—	Sun
Halesia carolina	Mountain Silverbell	C	white	Ap	green	5.0–6.0	X
Magnolia Soulangeana	Saucer Magnolia	C	white	Mr–Ap	red	5.0–6.0	Sun
Magnolia virginiana	Sweet Bay	C	white	My–Jy	red	4.0–5.0	X

Cunila origanoides, the American Dittany.—

September always finds the American Dittany in flower along dry wooded ridges near St. Louis. It is a delicate little plant of the Mint family, about two feet high when in blossom and bearing its small plumes of lavender-pink flowers well above its simple, light green leaves. It is easiest to recognize by its odor, from which it gets both its common and its specific name. The leaves when crushed smell almost exactly like wild marjoram or dittany and might well be tried out as a substitute for those flavorings.



Nymphaea gigantea var. *alba*

THE INTRODUCTION OF THE WHITE NYMPHAEA GIGANTEA

GEORGE H. PRING

In 1939, when the writer and Mr. Robert S. Trickett, of Ealing, London, were working together with species of Nymphaea in the Herbarium of the Royal Botanical Gardens at Kew, he mentioned a white form of *Nymphaea gigantea* from Australia. I was interested, for I had never heard of a white *gigantea* in cultivation, and he offered to try to contact some water-lily man who would collect seeds for me. The outbreak of the war, the following month, prevented all possibility of any one giving time for such details but it did not keep Mr. Trickett from corresponding. In September, 1945, he wrote to Mr. Albert De Lestang, of Adel's Grove Botanic Gardens, North Queensland, and received the following letter in reply:

Adel's Grove Botanic Gardens
Via Camooweal
North Queensland
10/11/45

Dear Mr. Trickett,

Your letter of 20/9/45, airmailed at 7:15 p.m. on that date, came to hand last night, 6 weeks and one day on the way. At this fast rate of air traveling I am afraid lily tubers would perish on the way . . . .

Now about that virgin-garbed beautiful nymph you desire. Beware of her fascinating beauty. My old friend, Mr. C. T. White, is getting short-minded from crowded work and roving about if he failed to tell you about the white nymph living here when he was at Kew some years back, for just before he went I sent him specimens of the floral belle. Mr. W. D. Francis, who is the acting boss in the absence of the chief, at that time could not be sure my white nymph was a *N. gigantea*. Our water nymphs are yet a bit mixed in names.

I will see what can be done about luring the beauty out of her watery home or robbing her babies (seeds) to be airmailed to you, if the fare is within my purse.

The white-flowered form of *N. gigantea*, as known here, is irregular in its appearance. I have not seen it the last two years. The type is plentiful in the gardens; thousands of blooms are floating about. Will keep an eye for the white form but it grows in deep water, here 30 ft. or more, coming to the surface on a root stalk 40 ft. or more long; the tubers beyond my reach, and the seed will be hard to get, for water beetles devour the stamens and ovules. The flower will have to be protected, and I do not know how it can be done. Will try anyway.

As to the white lilies with the blue ones in the pool near Rockland, Camooweal, I doubt their origin and how often seen. Will try to get in touch with the blacks there and get them to collect seeds if available; also will inquire from the roving blacks if white lilies are seen in other parts. Here only *N. gigantea* occurs . . . .

With Kindest Regards,
(signed) Albert De Lestang

In the next letter, seeds of the white-flowered *Nymphaea gigantea* were enclosed:

2/1/46

Dear Mr. Trickett,

In pursuance to my letter of 10/11/45, herewith enclosed please find seeds of *Nymphaea gigantea* white-flowered form, or purporting to be this plant. Seeds were collected by the bush blacks, and seeds alone have no means to identify them. Our natives have long lost their natural honesty and adopted the white man's wiles. I hope that the seed will turn all right to your satisfaction. Meantime I am keeping an eye on the garden pools for the white beauty in the event of the blacks having tricked us. I am also sending seeds to Mr. C. T. White, who was expected back in Brisbane last Christmas, to have them tried in the Botanic Gardens.

Soon after I wrote you the previous letter I contacted the bush blacks and after filling their "tucker bags" they readily agreed to get the seeds from shallow pools in the hills. They are expert at collecting these for to them they are the *equival* of wheat to the white man. From these seeds they make good native bread, as they do with other species we despise. You will remember the Old History telling us the so-called Nile Lotus which the trade foists upon the public as the Egyptian Lotus of the tombs and monuments was introduced in the Nile in the Roman period to stave off famine when the grain crops failed or all went to feed hungry Rome . . . .

I trust you received my previous letter okay. This one ought to have gone weeks back, but this place has been in blessful isolation since the 10th of last month by flood rains, and it is not known when the mail will next be through, though it has been fine the last few days. Camooweal P. O. is 180 miles from here; Burketown, the nearest, 140, but isolated by flooded coaster rivers at this period, our tropical wet season . . . .

With Kind Regards,
Yours sincerely,
(signed) Albert De Lestang

In May 1946 Mr. Trickett sent the Garden about 100 of the white Nymphaea seeds which he had received from Mr. De Lestang. Since *Nymphaea gigantea* is hard to bring into bloom during our short season for tropical growth, it was thought advisable to send half the seeds to Mr. A. J. Proebstle, of Brazoria, Texas, who has often collaborated with the Garden in growing water-lilies.

Mr. Proebstle planted the seeds on June 3, and on July 3 one had germinated (No. 1 plant). The seedling continued to flourish until sprayed with an insecticide which caused it to "go to sleep." The second seedling (No. 2) germinated soon after. Its first flower started to open on September 9, and was pure white. The plant was still in flower on September 20, at which time it was photographed (p. 53). The flowers were pollinated by hand, also by insects. In order to prevent cross-pollination from the blue-flowered plants the latter were not allowed to bloom in any of the pools. Up to October 20 the white-flowered plant had carried fifteen flowers and four seed-pods. Several hundred seeds were produced within these pods, some of which were sent to the Garden.

In October I made a special trip to Texas to see the white-flowered Nymphaea grown by Mr. Proebstle. Arriving in Brazoria at 6 p. m., October 19, I lost no time in viewing the No. 2 plant. The flower was then fully expanded and Mr. Proebstle told me that it stayed open day and night. I was sure that no water-lily did that, but he insisted that all of the fifteen flowers had closed the first night and remained open for the succeeding four nights. Being as I was from Missouri I had to be shown, so with the approach of darkness we again went out to the pools. Sure enough, the flower was still open. I was still not convinced and told Mr. Proebstle that it would be closed in about an hour according to all previous records of day-blooming water-lilies. At 10 o'clock, though, it was still wide open. It was hard to realize, even though some extraordinary things are done in Texas, and I prophesied that it would be closed in the morning. My host woke me at 6 o'clock in the morning, saying, "Put on your bath-robe and come out and look at the water-lily." The flower was still open, and it never closed from October 19 to October 23. Proebstle had noticed that the outer stamens always seemed to curl around the petals, and he concluded that this might be the reason that it couldn't close. This might be a contributing factor, but the stamens on the blue type also become reflexed.

The next point to be brought up was the No. 1 plant that went to sleep. The seeds had been sown on the surface of the soil in a large galvanized tub and covered with a thin layer of sand to prevent them from floating. That part of the tub where it had been planted was marked by a stake. I suggested that we look for a tuber there since our young plants in St. Louis had tubers the size of a pea. So the tub was lifted out of the water and Proebstle started to feel for the tuber, which we both figured would be about two inches below the surface of the soil. Sure enough, he felt something hard about an inch below the soil, and when the mud was washed out there was revealed a thin shoot with a swelling which was about to produce roots. The tuber, which had produced the shoot and seedling, was found eight inches below the surface of the soil and was the size of an English walnut. It was quite a surprise to find a new tuber as deep as that formed from seed that was planted on the surface five months before. In St. Louis we have noticed that Victoria seeds which have become buried five inches deep will extend their shoots to reach the surface. The question is: How does a tuber develop on the surface and then, with subsequent growth, push itself eight inches below.

The flower was cut on the sixth day for the purpose of study. There is no question that it is the pure white form of *Nymphaea gigantea*, the form *alba* listed by H. S. Conard in his "Monograph of the Genus Nymphaea" (Carnegie Inst. Washington, Publ. 4), in 1905. Following is a description of the Texas plant.

Description.—

FLOWERS white, fragrant, 6–8 inches in diameter, opening 4–6 days, closing only the first night. PEDUNCLE light green, supporting the flower 1½–2 feet above the water. SEPALS obovate-lanceolate, prominently hooded, outermost pale green suffused with white toward the margins, innermost sepals whitish with 10–12 light green veins, 6 of which are prominent. PETALS 17–20 in three rows, outermost row hooded, showing 9 veins, 7 being prominent at the base. STAMENS 600–800, Cadmium Yellow, incurved at the summit the first day, exposing the stigmatic center, later becoming reflexed, interior stamens rolling over the stigma. Filaments white, thread-like, the outside row the longest. CARPELS 14–20, separated from one another, particularly after ripening of the seed-pod. SEED-POD balloon-shaped, containing many seeds; flowers readily pollinated by insects; does not hybridize with other tropical day-blooming types (Brachyceras). RHIZOME spherical in the seedling stage, becoming ovoid when mature and showing prominent leaf and bud scars.

Submerged leaves triangular to hastate; first floating leaves ovate, pale green above and below, sinus broad. Mature leaves orbicular-ovate or elliptic, 1 foot or more in diameter, margin slightly wavy, sharply dentate, teeth short; upper surface at first brownish pink becoming pale green, under surface pale green with prominently reticulate veins. PETIOLES pale green, smooth, terete, 3–4 feet long.

A NEW HARDY PYGMY WATER-LILY

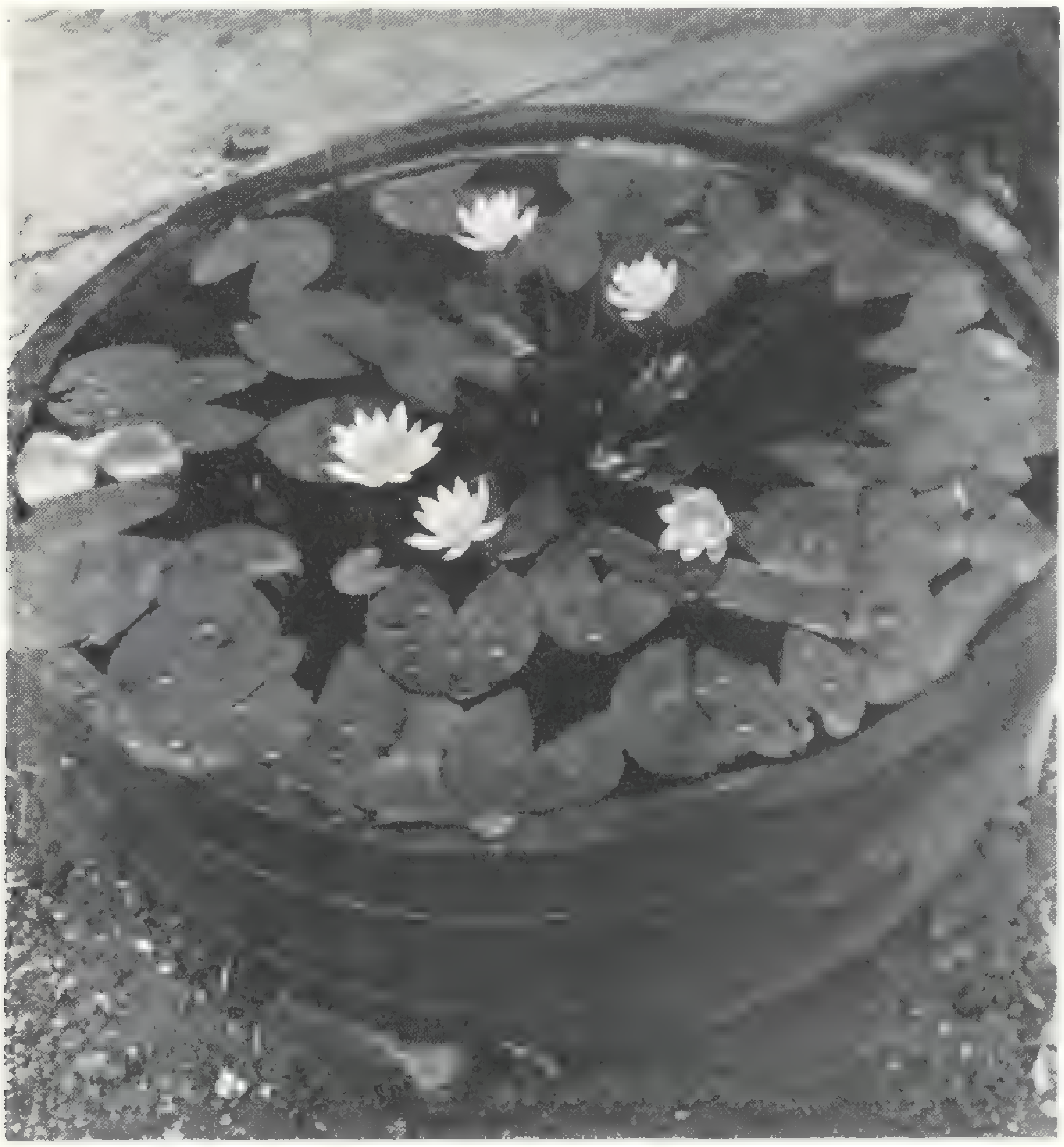
Nymphaea "Joanne Pring"

GEORGE H. PRING

In 1942 a pink sport from a yellow *Nymphaea helvola (N. tetragona* x *N. mexicana*) appeared in the Garden lily pools. Its pink color was constant when the plants were propagated by division of the multiple crown, and the color was reported fixed by both Mr. Robert S. Trickett, of London, England, and Mr. C. Tricker, of Saddle River, N. J., to whom plants were sent for trial. This pink-flowered variety is a welcome addition to the hardy pygmy water-lilies for tub culture, and has been named "Joanne Pring."

Plants growing outside in tubs will produce numerous flowers which are pink suffused with white toward the base, 3 inches across, rising 2–3 inches above the water the first day, afterwards floating at water level. The leaves are circular, 3 inches across, dark green above, pink underneath, when young occasionally striped with reddish-brown. The leaf stems (petioles) and flower stems (peduncles) are brownish-green. Fully developed plants develop a multiple crown.

Young plants in the greenhouse are hard to distinguish from the parent



Nymphaea "Joanne Pring"

N. tetragona, both having dark green leaves which are pink on the under side. The distinguishing character at this early stage is the petioles; those of *N. tetragona* are light green and those of the pink hybrid are brownish-green. The yellow hybrid, *N. helvola,* differs from both by its light green leaves, spotted or suffused with reddish-brown which shows on the under side. The petioles and peduncles are also light green. With age *N. helvola* also produces multiple crowns.

Description.—

SEPALS 4, oblong-lanceolate, 1–1½ inches long and about ½ inch wide, Dark Cress Green* on the under side, frequently lighter at the base and Lettuce Green suffused with white to pinkish toward the margins; upper surface whitish or faint pinkish, usually suffused with light green at the tips. PETALS 16, linear-lanceolate, acute-tipped, 1–1½ inches long and ½ inch wide, the four outermost longest, Rosolane Purple, whitish at base on the under side, with Lettuce Green tips and a prominent median stripe, suffused with deep pink (Rosolane Purple) toward the margins, usually lighter on the upper surface; inner petals smaller, more pronounced Rosolane Purple on both surfaces. STAMENS about 30, Light Cadmium Yellow (orangish) on inside, suffused with Rosolane Purple on outside, giving a burnt orange hue. CARPELLARY STYLES 12, Light Cadmium in color.

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*Color terms are those of Ridgway's "Color Standards and Nomenclature."

Gillenia stipulata, American Ipecac.—

It is curious how common certain wild flowers can be, and yet seem completely unknown to the general public. Gillenia is one of these, and though its dainty rose-colored flowers are very common in the rocky woodlands of Missouri in May and June, it never seems to reach popular attention. This may be because it blossoms at a time when the woods are hot and muggy and when mosquitos, chiggers, and ticks are all at a maximum. It certainly cannot be due to any delinquency on the part of the flower itself. The five delicate rose-colored petals are borne on dainty stems in loose clusters held well above the three-parted leaves which are set close to the stem and are attractively and regularly incised along the margin.

Choosing the worst sticktight in Missouri would be quite a task since there are so many of them but certainly Torilis would be among the leading candidates. This European weed looks very much like Queen Anne's Lace, but its seeds are covered with tiny hooks and it is a nuisance in wool socks or the ears of Cocker Spaniels. Since its seeds are ripe by midsummer it is troublesome over a longer period than are any of our other uninvited "fellow-travellers."

NOTES

The biology class of the Community High School of Carrier Mills, Illinois, visited the Garden, February 1, accompanied by their teacher, Mr. Norlan C. Henderson, formerly a graduate student at the Garden.

Mr. George H. Pring, Superintendent of the Garden, made a trip to Florida recently where he visited the Alberts orchid collection at Jacksonville, the Gore collection at Fort Lauderdale, and many smaller private establishments. He also visited the Fairchild Tropical Garden at Coconut Grove.

Hardly had the debris from the severe storm of September 1 been cleared away when a windstorm damaged the Garden on January 29. The wind reached a velocity of 37 miles an hour, breaking branches of trees and blowing off many vents in the Linnean House.

At the December meetings of the American Association for the Advancement of Science Dr. Edgar Anderson was elected Vice-president of the Botanical Society of America; Dr. Robert E. Woodson, Jr., Secretary-Treasurer of the American Society of Plant Taxonomists; and Dr. Henry N. Andrews, Jr., Chairman of the Paleobotanical Section of the Botanical Society of America.

Dr. Edgar Anderson and Dr. Henry N. Andrews, of the Garden staff, were among those invited to the Conference on Evolution which was held at Princeton, January 2–4. The conference was sponsored jointly by Princeton University, as part of its anniversary celebration, and by a committee of the National Research Council of which Dr. Anderson is a member. Two former graduate students of the Henry Shaw School of Botany also took part in the conference, Dr. Carl C. Epling, of the University of California at Los Angeles, and Dr. Marion Ownbey, of Washington State College, Pullman, Wash.

Recent visitors to the Garden library and herbarium include Mr. Walter H. Bangham, Geneticist Goodyear Rubber Plantations, San Jose, Costa Rica; Mr. Arno H. Bowers, of the American Amaryllis Society, Pasadena, Calif.; Dr. George J. Goodman, Professor of Botany, University of Oklahoma, Norman; Maj. and Mrs. R. S. Davis, orchid enthusiasts, of Dayton, Ohio; Mrs Francis King, well-known horticultural writer; Dr. Carl O. Sauer, Professor of Geography, University of California, Berkeley; Dr. H. G. Quaritch Wales, of the book-firm, Bernard Quaritch Ltd., London, England; Miss Patricia Poindexter, botany major, University of Arkansas, Fayetteville; Dr. Carl George Deuber, of the Stauffer Chemical Co., Ardsley, N. Y.; Mr. Richard D. Schein, botany major, DePauw University, Greencastle, Indiana; Mr. K. M. Broman, Superintendent, Royal Botanic Gardens, Hamilton, Ontario, Canada.

It is a great pleasure for the Garden to announce that at the 43rd annual meeting of the American Society for Horticultural Science, held in Boston, December 27–29, 1946, Dr. Gustav A. L. Mehlquist (Horticulturist at the Missouri Botanical Garden and Associate Professor of Botany at Washington University) was presented with the Leonard H. Vaughan Memorial Research Award in Horticulture, carrying with it a remuneration of $500.00. Two such awards are made each year by the Society, the funds being contributed by the Vaughan Seed Stores of Chicago in memory of Mr. Leonard H. Vaughan. One of these awards is made for distinctive work with vegetable crops and the other for an outstanding contribution in floriculture. Dr. Mehlquist's award was made in recognition of his hybridization work with carnations. The results of this research were published in the Proceedings of the Society for 1945, under the title "Inheritance in the Carnation. V. Tetraploid Carnations from Interspecific Hybridization."

Lemon Balm in Missouri.—

The Lemon Balm, *Melissa officinalis*, was recently found to be growing wild in great profusion in a woodland near Ferguson, Mo., and from time to time it has been reported on wastelands and along roadsides in various parts of the state. Lemon Balm is a humble-looking plant, in general appearance something like a greener catnip, but it has one of the most distinguished aromas in the entire plant world. The plant is a perennial with heart-shaped scalloped leaves, and for centuries it has been grown in gardens for its lovely odor which is something like that of the Lemon Verbena. Years ago it was used in medicine on the theory apparently that anything with such an appealing smell should be of some use. Modern scientific medicine however has not justified this prejudice, and today it is merely a harmless roadside plant (one cannot call it really a weed) or a subject for those occasional gardeners who interest themselves in old kinds of plants which have had a long association with mankind.

Wisteria in Missouri.—

Missouri has a native Wisteria in its swampy southeastern corner, and while most of the plants have been exterminated in the ditching and draining of that area they still persist commonly enough to amaze visitors in late spring and early summer. *Wisteria macrostachya,* the species in question, is surprisingly similar to the cultivated Oriental species and it is occasionally transplanted to our gardens, though its blossoms are ineffective compared to those of its Oriental cousins. Nowadays it is most frequently seen along drainage ditches and railroad rights-of-way, climbing up luxuriantly above bushes and small trees and bearing its gray-blue racemes of flowers in considerable profusion.

THE MISSOURI BOTANICAL GARDEN

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN

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Volume XXXV March, 1947 Number 3

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Missouri Botanical Garden Bulletin

Vol. XXXV MARCH, 1947 No. 3

GROWING ROSES

PAUL A. KOHL

The rose is the only flower that every one knows and loves. Many books on rose culture have been written, and every garden magazine devotes pages to this flower each year. New varieties are constantly being added to the already-long list of hybrid tea roses; membership in the American Rose Society is on the increase; local rose societies are being formed in many communities, one of the most recent being in St. Louis; and so the interest in the rose continues unabated. Small wonder, then, that information is constantly being sought by those who are just taking up rose culture, or by those who are meeting with difficulties or are interested in enlarging their collections.

Current rose catalogues place considerable emphasis on hybrid tea roses. They are first, if the popularity of the different groups of roses is measured by the number of varieties offered in the catalogues, some nurseries listing between seventy and eighty varieties. Polyanthas and their large-flowered cousins, called floribundas, are second with fifteen to twenty varieties; and climbing roses are third, the list of available varieties being from twelve to thirty-five. Other groups, but of less importance, are the pillar roses, the shrub roses, the old-fashioned roses and the miniatures.

Hybrid Tea Roses.—These roses are practically ever-blooming; they commence flowering in May and continue until frost. Given a reasonably good soil all varieties will thrive in the garden, and if they are protected during the winter they will grow in succeeding years. Roses, like people, are individuals, and some varieties are sturdier than others. Thus, in time certain roses are recognized throughout the country as being superior, and these maintain their popularity for many years. The rose catalogues picture and describe many new roses each year. A beginner will find it difficult to select a few good varieties without some guidance, but he can be assured of purchasing good ones if he selects those marked with the insignia bearing the letters "AARS." Varieties so marked represent the "All American Rose Selections," being reliable roses after they have had a thorough trial in all parts of the United States. Another source of information is the "Proof of the Pudding" in the American Rose Society's annuals, which contains comments on the performance of the newest roses by rose growers from different parts of the United States.

Polyantha Roses.—The word "polyantha" means many-flowered. Formerly most of the roses in this group had small flowers, but in recent years hybridizers have created varieties with flowers nearly as large as the hybrid teas, and these have been called "floribundas." As a group they are very popular because they bloom so freely throughout the season and are fine for mass displays in the garden.

Hybrid Perpetuals.—Many years ago hybrid perpetuals were almost the only roses grown. They can stand the changeable winter weather better than the hybrid tea roses. The flowers, for the most part, are double, pink, red, or white, with a few partly yellow; some are very fragrant, others slightly so or not at all. The plants are tall, and some varieties have very thorny canes. Their best period of bloom is in June, only a few varieties, as "Frau Karl Druschki," producing a second crop of flowers in late summer.

Shrub Roses.—Closely resembling the hybrid perpetuals in hardiness and vigorous growth are the various shrub roses, such as rugosa roses, sweetbriers, and the species roses of which our native prairie rose, *Rosa setigera,* is an example.

Climbing Roses.—From the standpoint of flower size and time of bloom the climbing roses may be divided into two groups: the large-flowered ones which commence to bloom about May 15, and the small, cluster-flowered ramblers which bloom during the first and second week of June. The climbing hybrid tea roses represent a class that blooms during the summer and fall. They require several years to become established and must be protected during the winter.

Miniature Roses.—These dwarf fairy roses are charming reproductions of the large-flowered hybrid tea roses. The buds of some of them measure less than one-quarter of an inch and yet they are as perfectly formed as any of the larger roses. Since the plants are small they should be grown in separate beds or in pots.

The Rose Bed.—Hybrid tea roses may be grown along the front of shrub beds or planted among perennials, but when a dozen or more are grown it is

HYBRID TEA AND SHRUB ROSES IN GARDEN OF MRS. GEORGE W. TAYLOR

simpler to care for them in one bed. Roses should receive at least half a day of sunshine. If they are planted near shallow-rooted trees, such as the elm and maple, they suffer not only from the shade cast by the trees but also from lack of water and food which the tree roots take. Low places are undesirable for rose beds. Because the soil is wet most of the year, the plants are in danger of being heaved by the frost in winter and finally killed.

Soil.—In this area the soil is a fairly heavy clay loam, and if other plants have been grown successfully in it for some years it is in reasonably good condition for roses. So often, however, the soil about the home consists mostly of subsoil which was spread after the house was built. In the process of leveling much of the building material, such as sand, mortar, broken bricks and roof tiles, was covered with a few inches of soil. It is a chore like the removal of this building trash from the soil that takes the joy out of gardening, but it must be done. About the best way to proceed with the preparation of a rose bed is to remove the upper six inches of soil and throw it to one side. Bonemeal and superphosphate is then spread in the trench at the rate of about three pounds of each to every 100 square feet of bed area. This is spaded into the subsoil and then the topsoil is returned to the bed. Both layers of soil will be improved by the addition of leafmold or peat moss at the rate of two to four bushels to every 100 square feet of bed. A good compost pile should be maintained in every garden to supply additional humus whenever it is needed. A newly spaded rose bed should be allowed to settle several weeks before the roses are planted. If this is not possible, then the soil should be firmed as it is returned to the bed.

HYBRID TEA ROSE "PEACE"

CHINA ROSE "HERMOSA"

Rose Plants.—Almost all the roses that are purchased from nurseries or stores are budded plants, as this is the method by which roses are produced commercially. Many rosarians, however, grow their own plants quite successfully from cuttings. Dormant roses should be planted in March if possible, and planting may be continued into April. The later in spring dormant roses are planted the less chance they have of becoming established before warm weather sets in. Pot-grown roses may be planted any time and will grow if carefully handled so that the ball of soil surrounding the roots does not fall apart. Roses may also be planted in October or November providing the plants are obtainable. In December weather conditions usually prevent proper planting, and the soil is too cold for any root action.

Planting.—Roses should be unpacked soon after being received. If it is impossible to plant them immediately they should be "heeled-in," that is, the roots and most of the tops covered with damp soil.

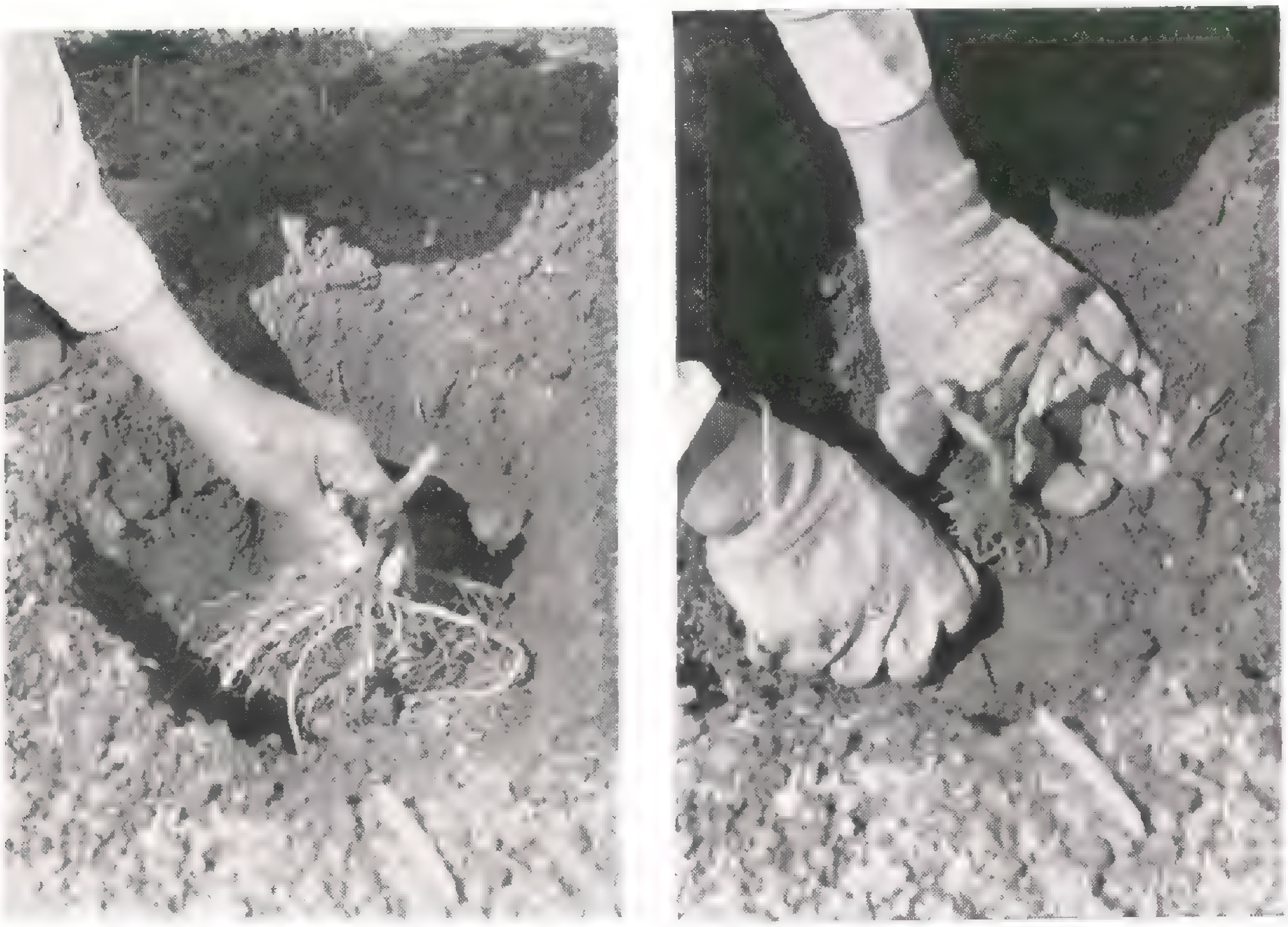
It is surprising how rapidly roses dry out when they are exposed to the wind and sun while the holes are being dug. To avoid this, the plants may be taken to the garden in a bucket of water or the roots may be dipped in water and the plants wrapped in paper or burlap.

The hole to receive the rose should be large enough to accommodate the roots without crowding. Leave a slight mound or cone of soil in the center and on this spread the roots. The knob (that place where the rose is budded) should be level with the surface of the soil. This will allow for settling and eventually the budded portion will be an inch beneath the surface. Work the soil between the roots with the fingers. (A good pair of leather gloves will be found indispensable for this work.) Add more soil as needed and finally firm with the feet. Leave a depression around each plant, into which pour a half pail of water after all the roses are planted. This helps to settle the soil and prevents any loss of roses from drying out. When the water has drained away the remaining soil is drawn around the plants and mounded to about six inches to protect the buds until they form new shoots. Later this soil is washed down by rains or leveled off when the beds are cultivated.

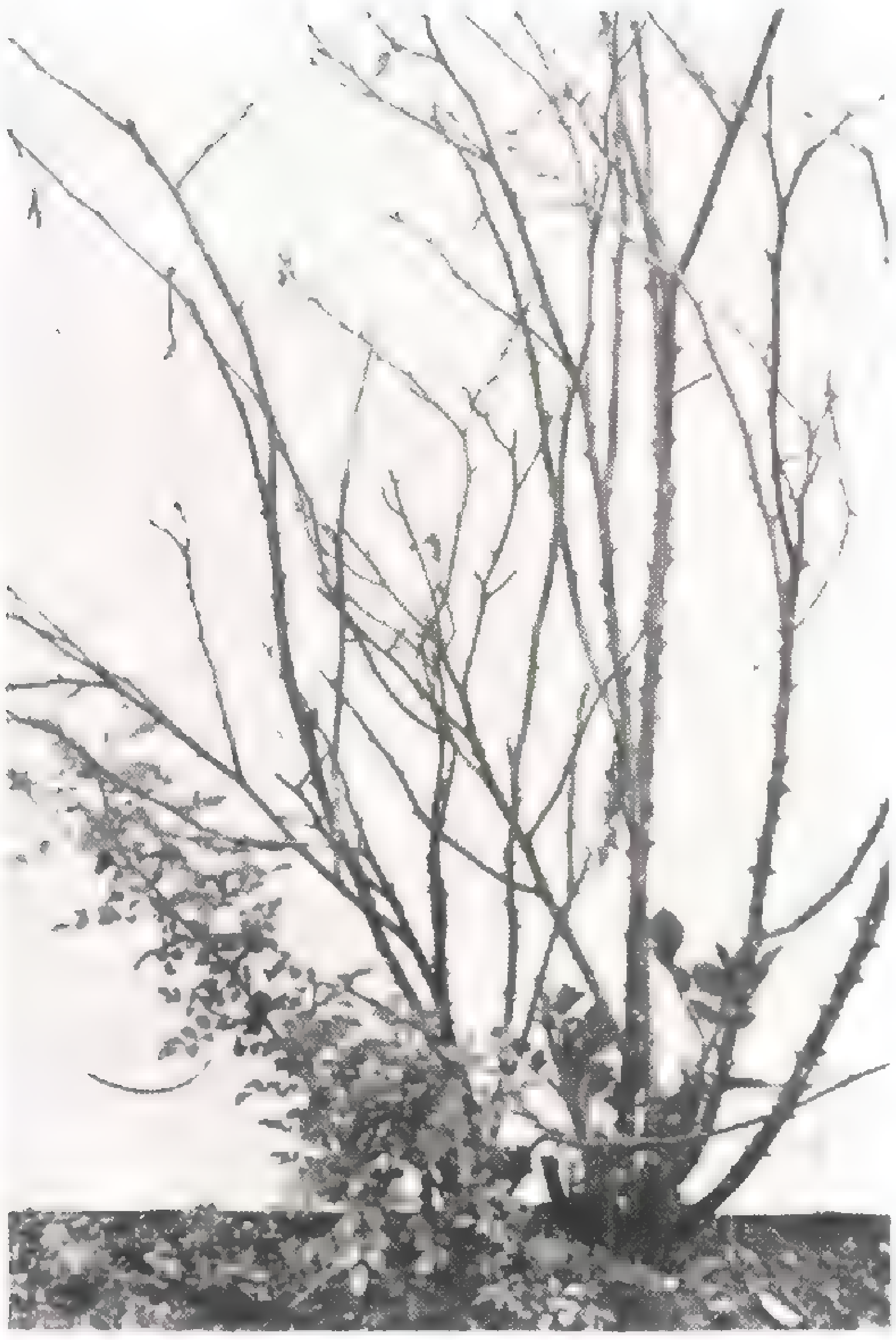
Planting Distances.—The dwarf polyanthas and the majority of hybrid tea roses should be planted fifteen to twenty inches apart; large hybrid tea roses, as "Radiance," two feet; hybrid perpetuals, two to three feet; and rugosa and shrub roses at least four feet apart. Climbing and rambler roses are planted singly at the bases of arches or pillars. On fences or trellises they should be spaced eight to ten feet apart, while unusually strong-growing varieties, like "Dr. Van Fleet," may be even farther apart.

Watering.—Drought periods may occur in June, July or August. When the upper layer of soil becomes dry the growth of the bush roses is checked. Shrub and climbing roses have a deeper root system and do not show the effects of drought so quickly. Rose beds should be soaked once or twice a week during dry periods, the early morning being a good time if a fountain sprinkler is used. Wetting of the foliage in the evening tends to spread diseases. If the rose beds are watered in the evening it is better to use a canvas hose soaker or to flood the beds with the open end of the hose laid on a board to prevent washing the soil.

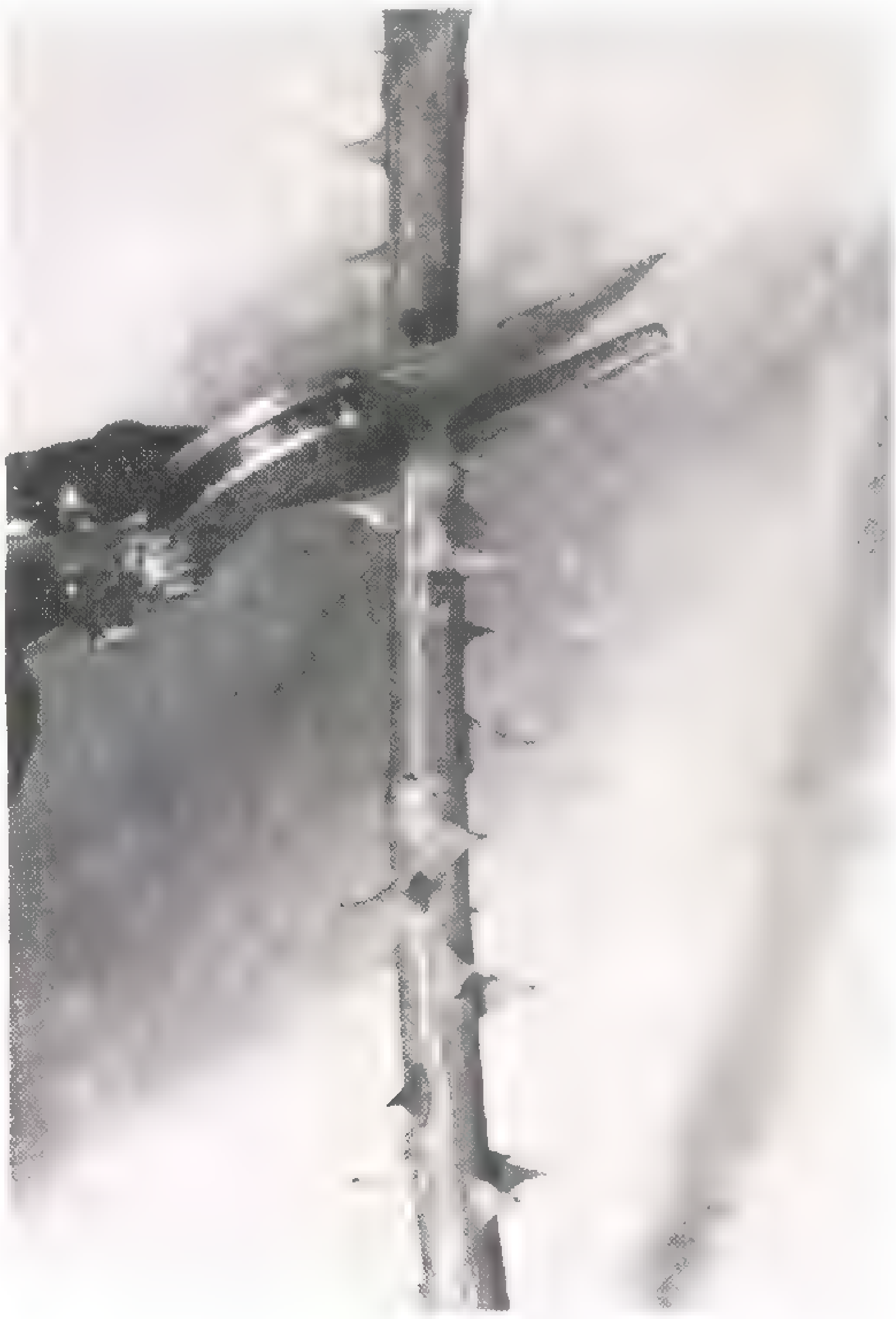
Insects.—Since the insects which attack roses do most of their damage early in the season it is wise to have the materials on hand with which to fight them, also sprayers and dusters in working order. Gardeners should



PLANTING A DORMANT ROSE



HYBRID TEA ROSE IN MARCH
Remove weak and dead canes and sucker at left



PROPER PRUNING CUT ABOVE A BUD

learn to recognize the kind of insects which feed on roses and know the remedy.

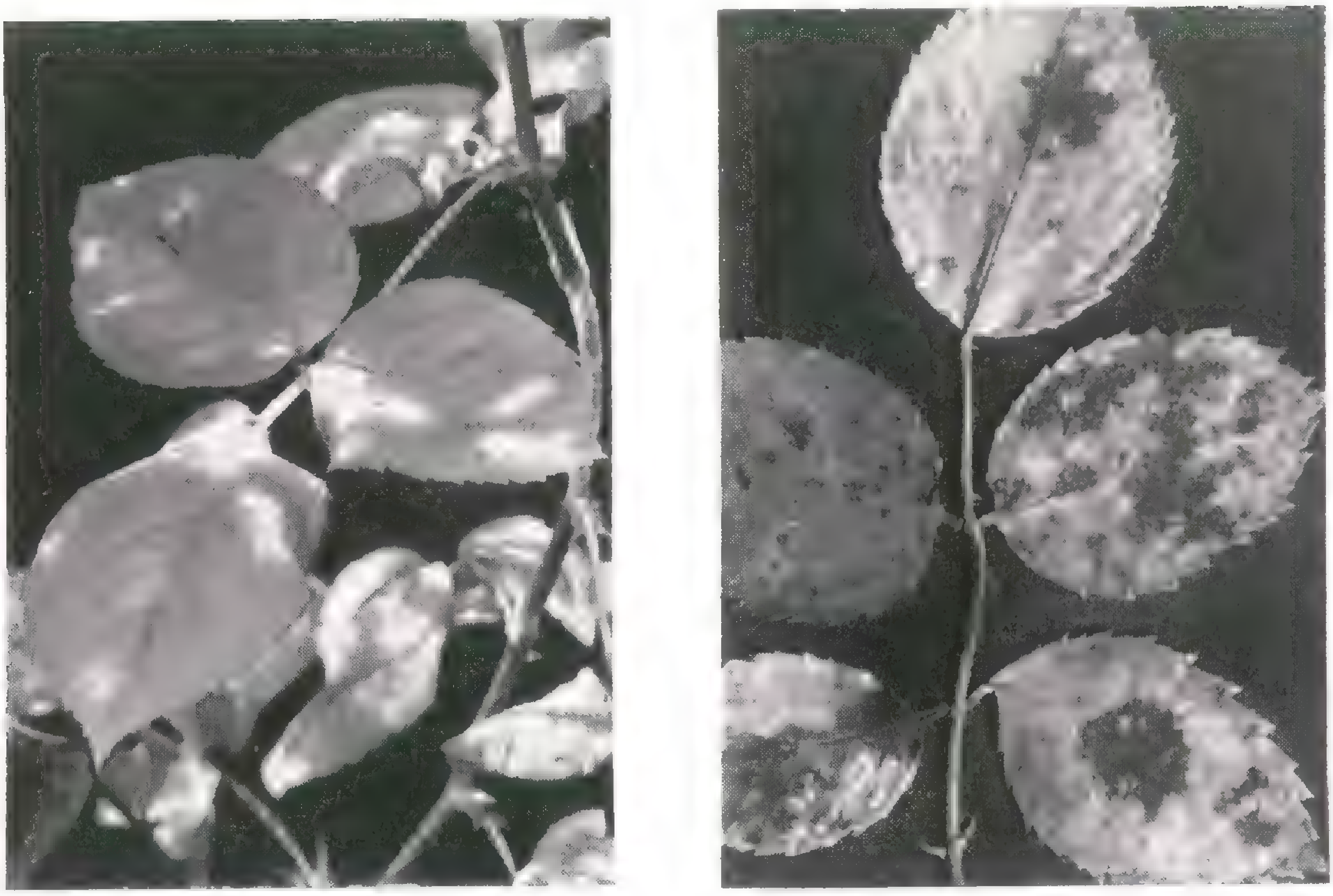
Aphis appear each spring. They are easily controlled if the roses are sprayed with any contact insecticide containing nicotine or pyrethrum. Sometimes they are tough and a double-strength solution is needed to kill them. Another infestation occurs a few days later when those with wings are blown in by the wind, and this calls for a second and third spraying.

A number of chewing insects appear every year, of which the rose slugs are the worst. They skeletonize the leaves so quickly that the damage is done before the spray gun has been brought into play. They begin feeding on the underside of the leaves in May and do most of the damage by early June. If the roses are sprayed in early May with arsenate of lead and again after heavy rains in anticipation of an attack, the slugs will be controlled. Several kinds of beetles eat the tips of rose buds or bore into them. Leaf cutter bees cut perfect circles from the leaves, and, like the beetles, they are difficult to control. Stem borers sometimes injure rose canes. They enter the stem where it has been recently pruned and as they bore down they interfere with the flow of sap. Very little can be done to prevent this type of injury. The pruning cuts are sometimes painted or covered with grafting wax, but it is questionable whether the time spent in treating each wound is worth the effort.

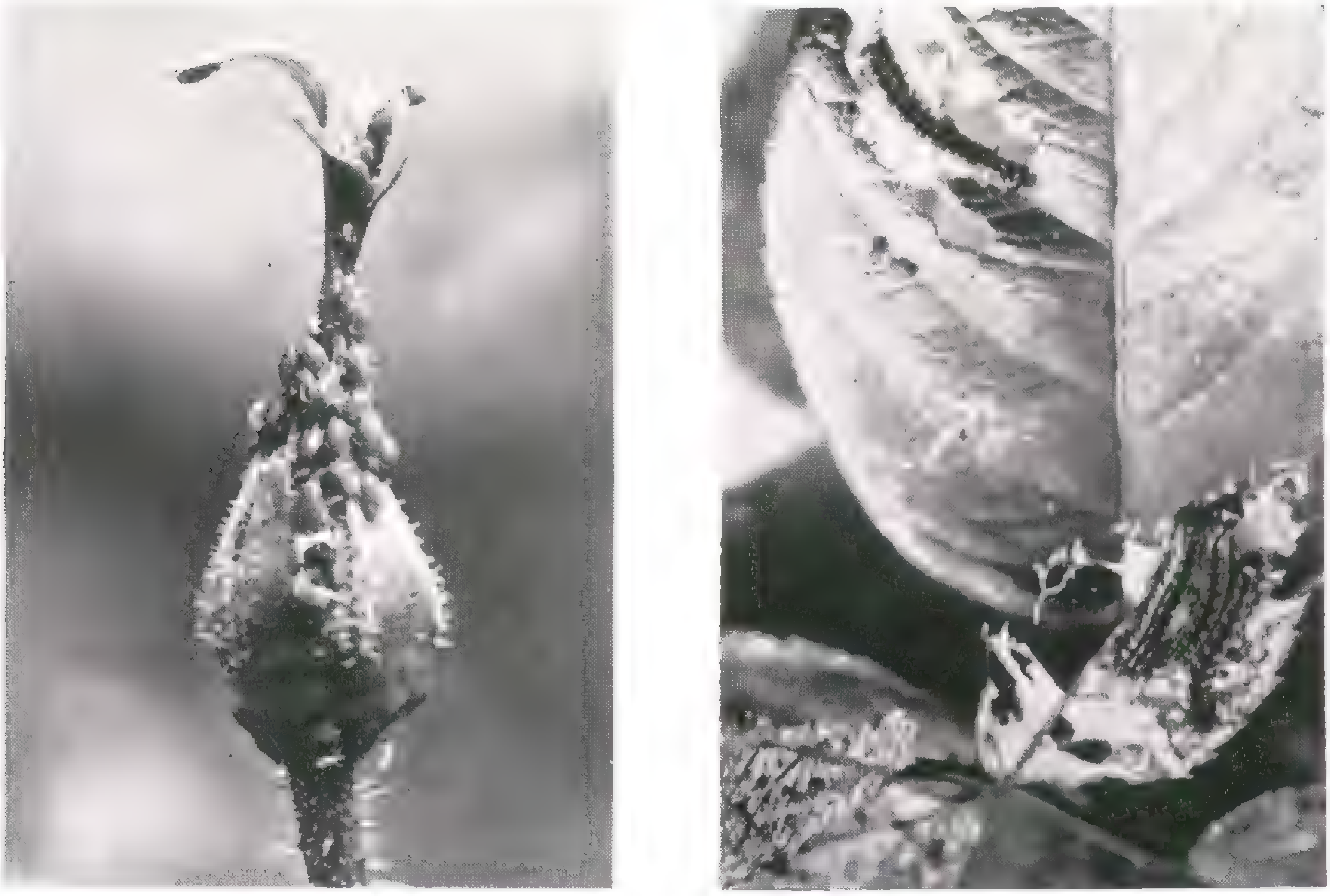
In some years red spider causes partial defoliation of the roses during June and July. These mites draw the sap from the underside of the leaves, and to dislodge them the plants should be syringed with a strong stream of water. Dusting sulphur is somewhat effective but it also injures rose leaves if the temperature is above 90 degrees.

Some roses, particularly the rugosas, are subject to various scale insects, such as oyster shell and scurfy scale. When the entire cane is covered with scale it should be cut away at the base of the plant and burned. Spray these roses with an oil spray during the winter.

If tender rose tips wither and turn black and few flower buds develop during the summer, it is quite certain that rose midge has invaded the garden and the injury is not due to heat as was formerly supposed. This insect has been prevalent in greenhouses for many years, but only about ten years ago was it recognized as a serious garden pest. Dr. W. E. Blauvelt, of Cornell University, has been studying this insect and its control and on various occasions has reported his observations in the American Rose Annuals. In describing his work in the 1946 Annual, Dr. Blauvelt considers DDT the most promising insecticide and recommends about 1½ tablespoonfuls of 25% wettable DDT powder to one gallon of water. This may be combined with the other new spray material "Fermate," and if the Grasselli Spreader



MILDEW BLACK SPOT



APHIS CATERPILLARS

DISEASES AND INSECTS

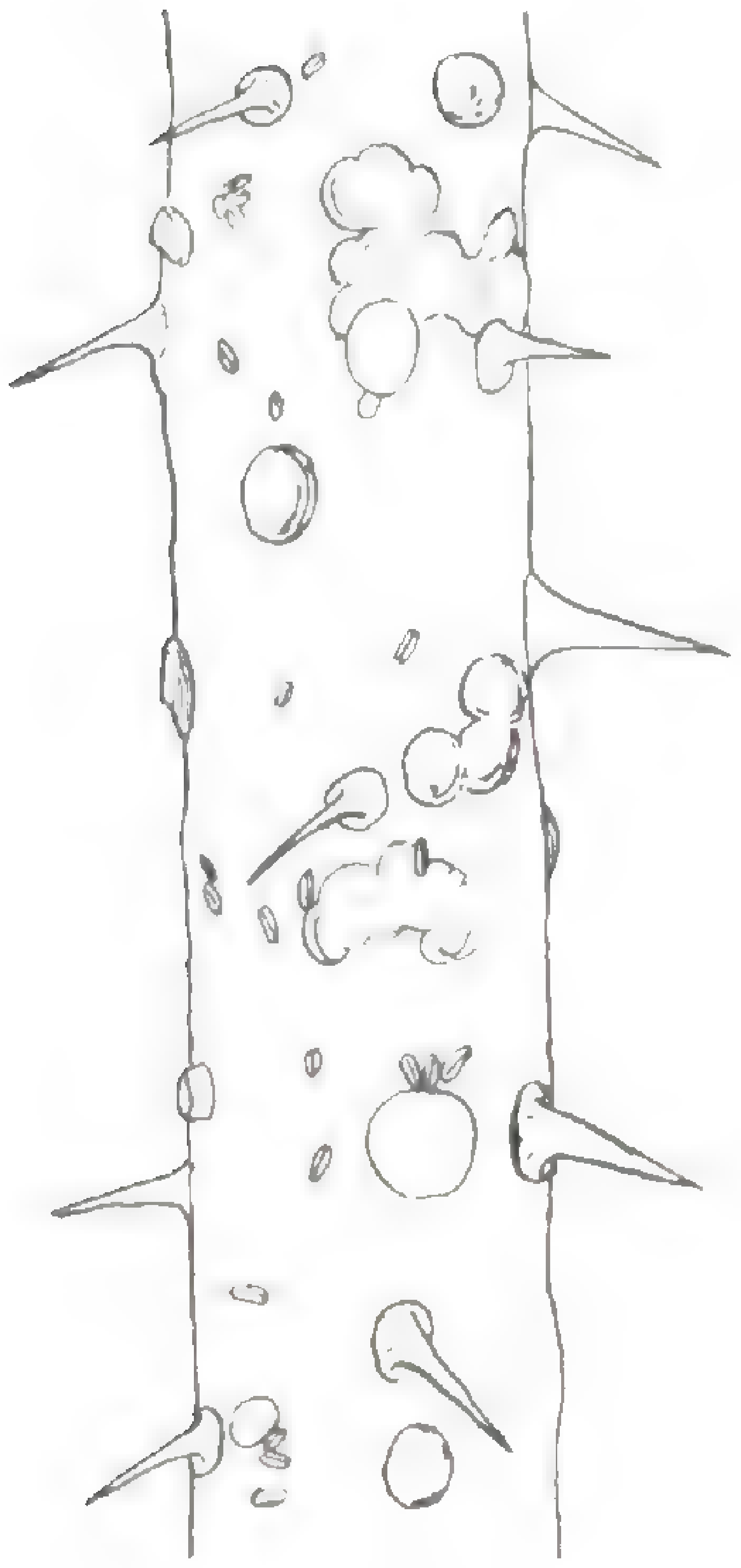
Sticker is added we have one of the finest combination sprays, that will control a number of insects and the diseases affecting the rose.

Diseases.—Several fungous diseases plague the roses, the most serious one being black spot. It occurs in every rose garden, and the intensity of the attack varies each year with weather conditions. The disease is on the roses long before it is recognized, but by the time the leaves develop the characteristic spots and drop to the ground it has made such inroads that nothing can be done to prevent premature defoliation. The control of black spot calls for a spraying or dusting program that continues uninterruptedly from spring until fall. For many years Massey dust (named for Dr. L. M. Massey, of Cornell University, who has done much research on black spot) has been the standard spray or dust in controlling this disease. Massey dust consists of 9 parts dusting sulphur and 1 part arsenate of lead. If roses are dusted or sprayed at ten-day intervals, and with an occasional extra dusting during rainy periods, one can feel reasonably sure of checking this disease. It is not possible to stamp it out but it can be held in check. The new material, "Fermate," has given promising results in black spot control. Any other diseases which affect roses will be controlled by the same fungicides used for black spot, with one exception—Fermate will not control mildew.

Dusting and Spraying.—Gardeners have a choice of dusting or spraying their roses. Either way is effective and each has certain advantages. Dusting guns are quickly loaded and can be used on short notice, as just before a rain. They are also cheaper than sprayers, and the latest types weigh less and are very easy to use. In order to get good coverage, dusting must be done when there is little wind, in the morning or the evening. The wearing of goggles is recommended, for if sulphur gets in the eyes they smart for some time.

Fermate can be stirred into dusting sulphur in a bucket in much the same way that paint is mixed, using 10 per cent Fermate and 90 per cent dusting sulphur. DuPont's Garden Dust contains DDT, Fermate, Rotenone, and several other materials which makes it an all-purpose dust. Pomo-green with nicotine is another fungicide easily used in the duster, as is also Massey dust which has already been mentioned.

Good quart-size compressed-air sprayers and the larger two- and three-gallon ones are again available for those who prefer to use liquids instead of dusts. Tri-ogen, the all-purpose spray, will control sucking and chewing insects and fungous diseases. Wettable sulphur can be used at the rate of 2 tablespoonfuls to one gallon of water, plus 5 to 8 drops of Grasselli Spreader Sticker. Fermate is used at the rate of 2 tablespoonfuls to the gallon of water or, if combined with sulphur, 2 teaspoonfuls of Fermate and 2 table-



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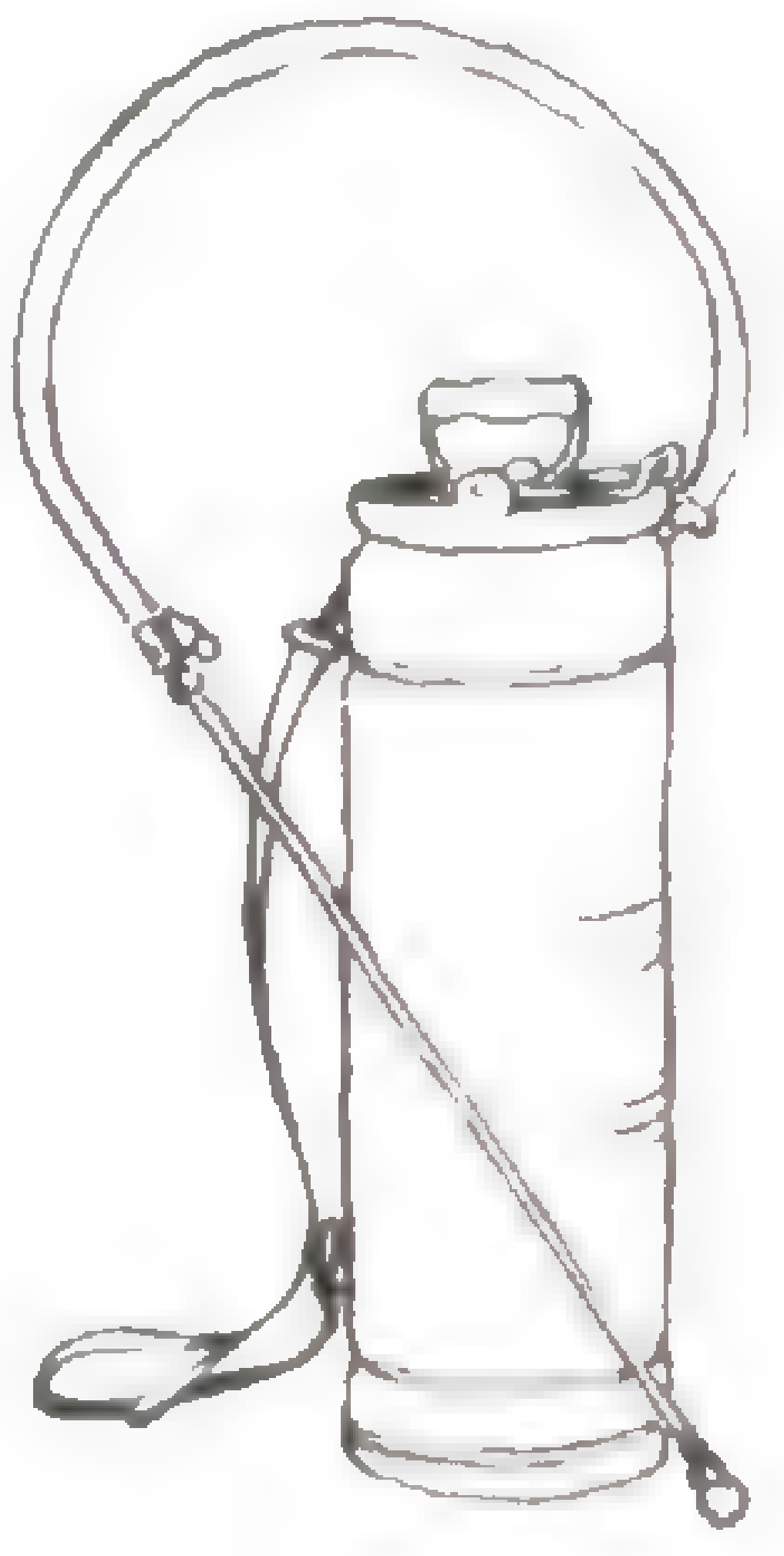

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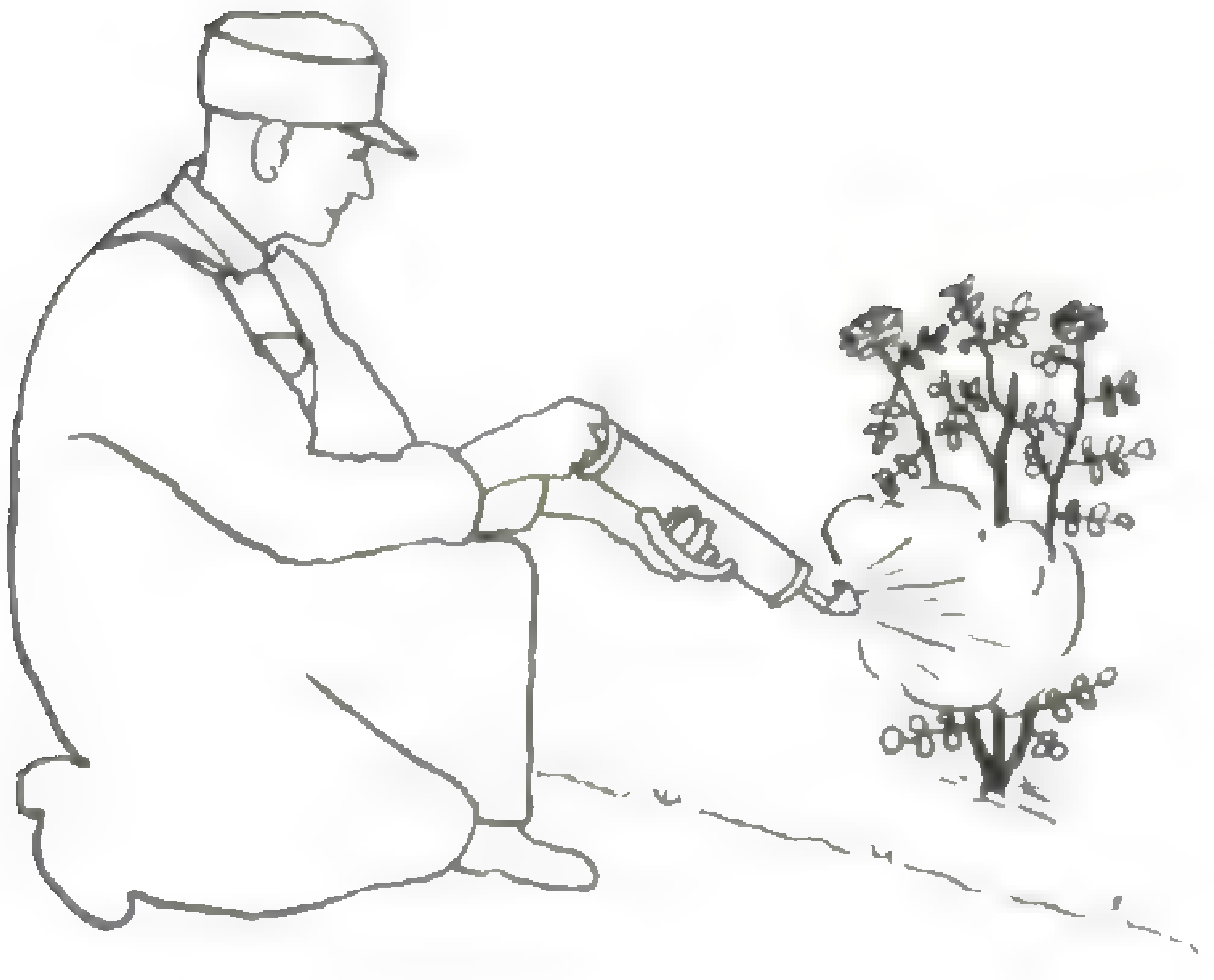

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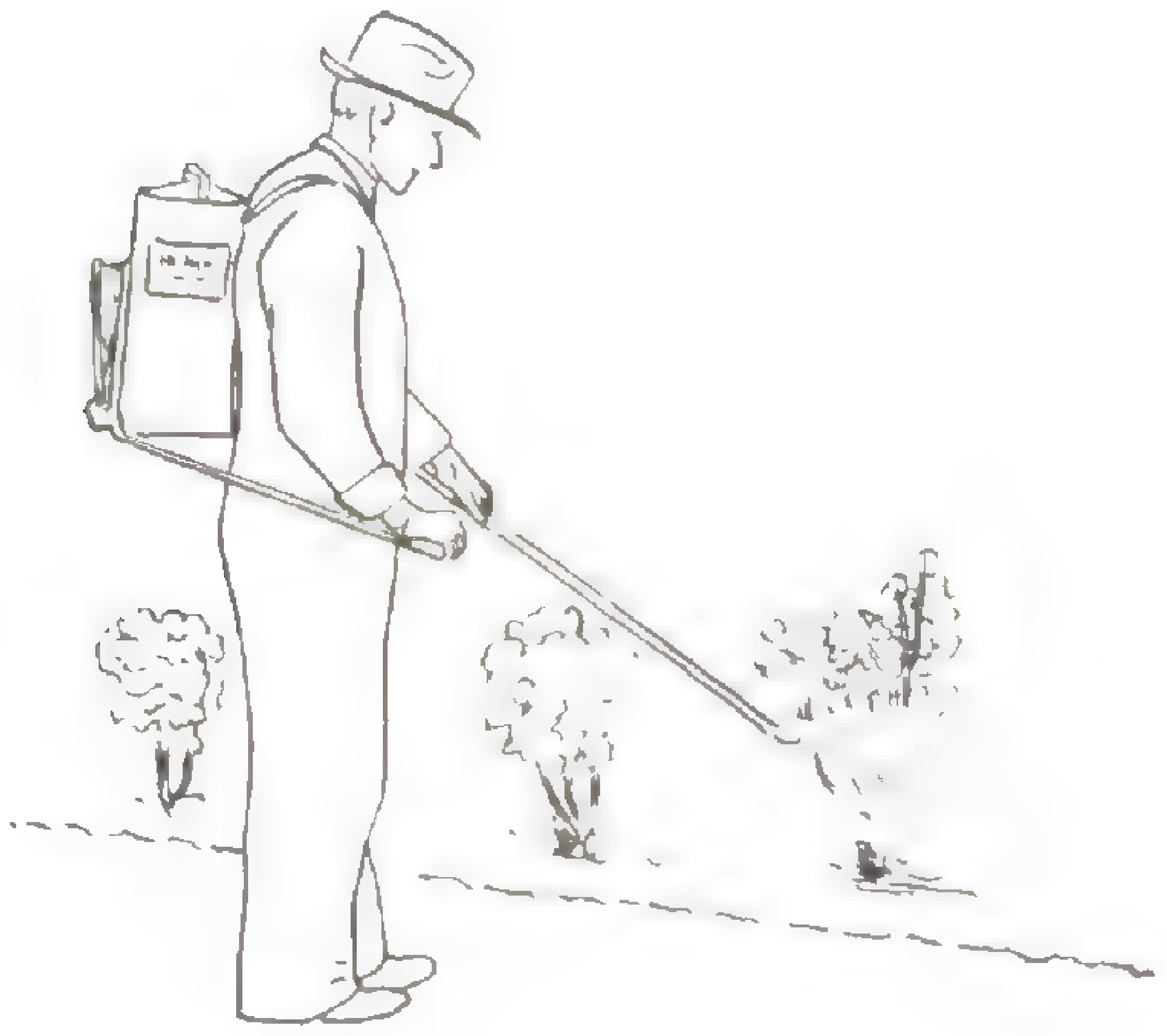


4

1. SCURFY SCALE ON RUGOSA ROSE
2. COMPRESSED-AIR SPRAYER
3. SMALL DUSTER
4. LARGE DUSTER WITH BELLOWS

spoonfuls of sulphur to the gallon. A ten-cent set of aluminum measuring spoons is an indispensable item for the gardener's spray shelf. Fermate and DDT do not mix well with water. DDT should be shaken with a cupful of water in a Mason jar before being added to the full amount of water. In making Fermate solution stir about 8 drops of spreader sticker into one gallon of water in a large glass jar and then float 2 tablespoonfuls of Fermate on the water. Let this stand to permit some of the powder to settle to the bottom. After fifteen minutes the mixture is stirred and poured into the spray tank. Sprayers should always be shaken periodically while being used as most of the mixtures settle to the bottom.

The success or failure of the various fungicides is directly dependent upon the timing of the applications. Frequent rains necessitate several dustings or sprayings. During dry weather the applications can be spaced at two-week intervals and during the hottest and driest weather dispensed with entirely. Sulphur injures the leaves if used when the temperature is above 90 degrees. Fermate can be used alone during those periods as a spray or combined with talc instead of sulphur.

Fertilizing.—The following fertilizers for roses are suggested:

Commercial fertilizers with a 4-12-4 or similar formula. Apply half a handful to a plant and cultivate it into the soil in April and June. Use more for large climbing and shrub roses.

Concentrated liquid fertilizers (4-8-4). Use about a tablespoonful to one gallon of water.

Rose food (7-8-5).

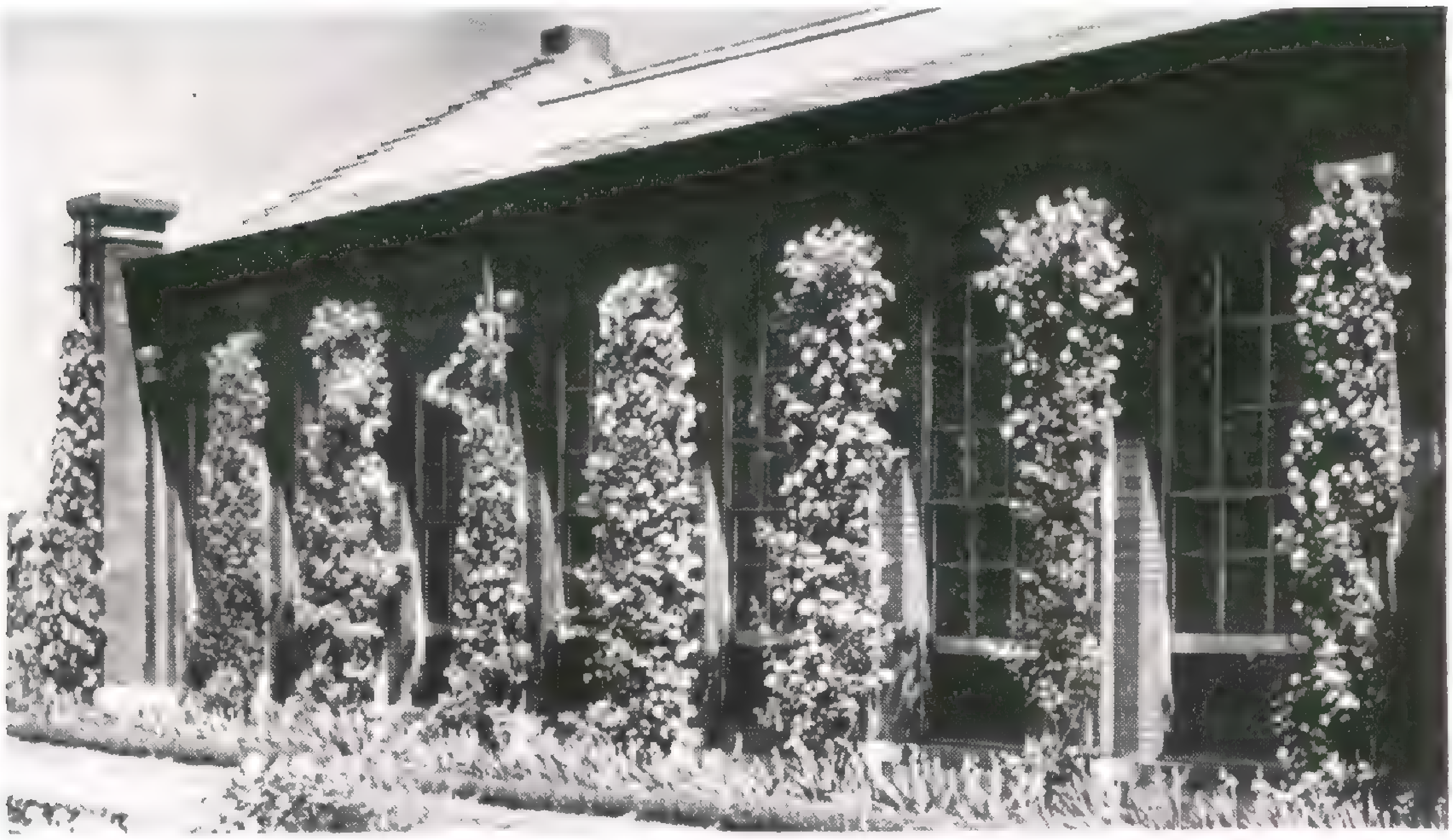
Dried and shredded cattle manure.

Liquid cow manure (1 bushel of fresh cow manure in a 50-gallon barrel of water). This proportion may be varied for a smaller container. Let the cow manure and water stand for several days and then use 1 to 2 pints of the manure water to 2 gallons of water. Apply half a gallon to each rose about every two weeks. The soil should be moist when any liquid fertilizer is used. Where is the cow manure? As a last resort gather a few pancakes from a pasture the next time you take a ride in the country.

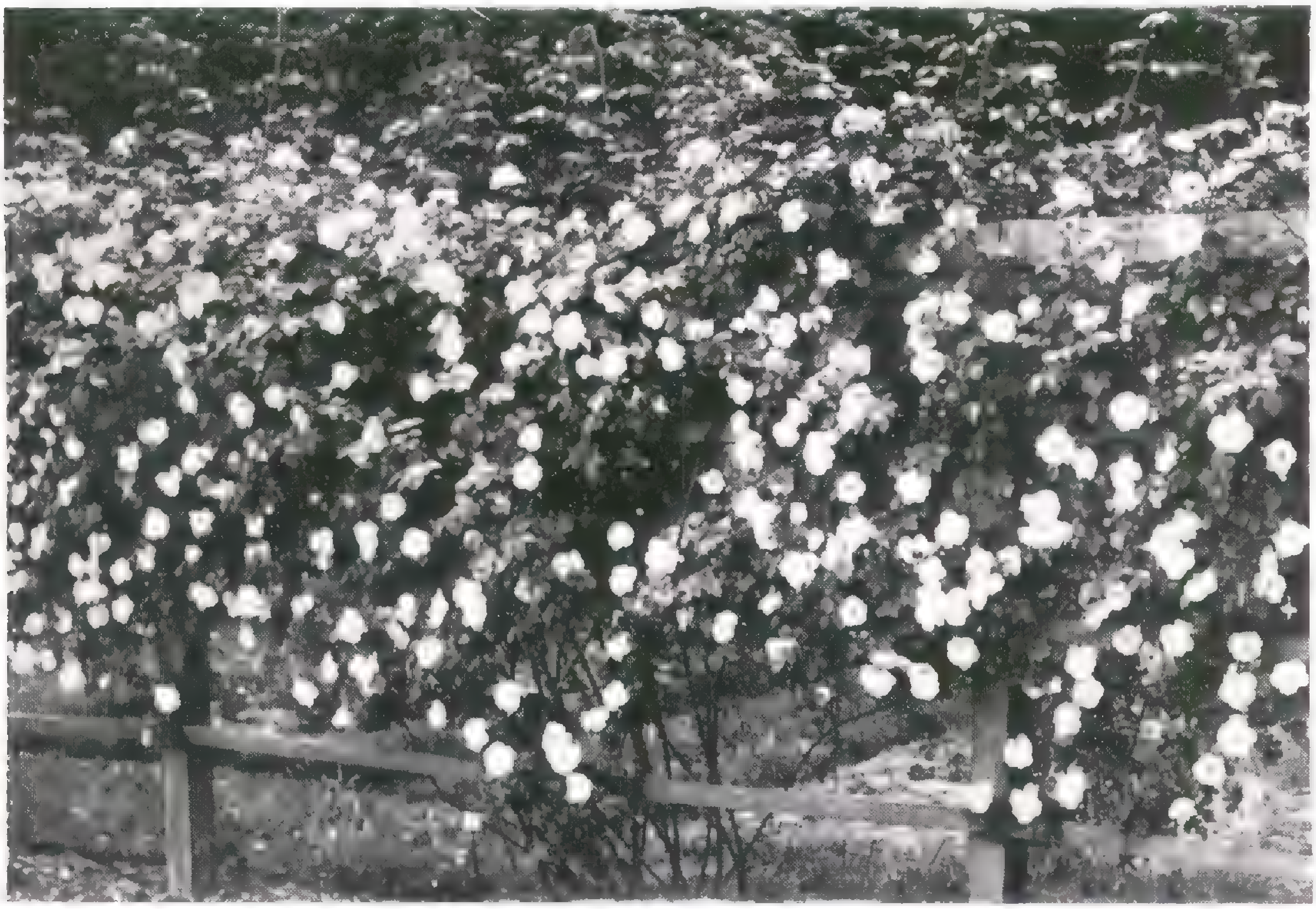
Discontinue feeding roses by August 15.

The problem of rose fertilization is complex, and there is still much to be learned. Almost every issue of the *American Rose Annual* or *The Rose Magazine* contains information on this subject which gives a fuller appreciation of the problems involved.

Summer Mulching.—An artificial mulch during summer prevents weeds, conserves moisture, and insulates the soil against the hot rays of the sun.



CLIMBING ROSES ON LINNEAN HOUSE
From left to right: Purity, Milky Way, Wartburg, Christine Wright, Purity, Mary Wallace, Dr. W. Van Fleet, Paul's Scarlet Climber



CLIMBING ROSE "DR. W. VAN FLEET"

Peat, buckwheat hulls, and spent hops may be used. About a two-inch layer of any of these materials should be applied to the rose beds in early June and left until the end of August or early September. Mulching material should not be heaped around the base of the roses as the stems are sometimes burned when the weather is damp and hot. Some rose growers contend that artificial mulches aid the spread of black spot.

Pruning Climbing Roses.—The term "climbing roses" is applied to the large-flowered varieties whose flowers are borne on laterals a foot or more long. These roses do not produce numerous canes from the base of the plants each year but many of the new growths start from the two- and three-year-old canes. The "rambler" roses, "Dorothy Perkins," for instance, annually produce many strong and fast-growing shoots from the base of the plant. Both climbers and ramblers should be pruned during the summer. The large-flowered kinds should be thinned so that half of the remaining wood is two or more years old and the other half of the current season's growth. Varieties such as "Dr. Van Fleet" grow so rapidly after the summer pruning that it becomes necessary to do some additional thinning in the spring.

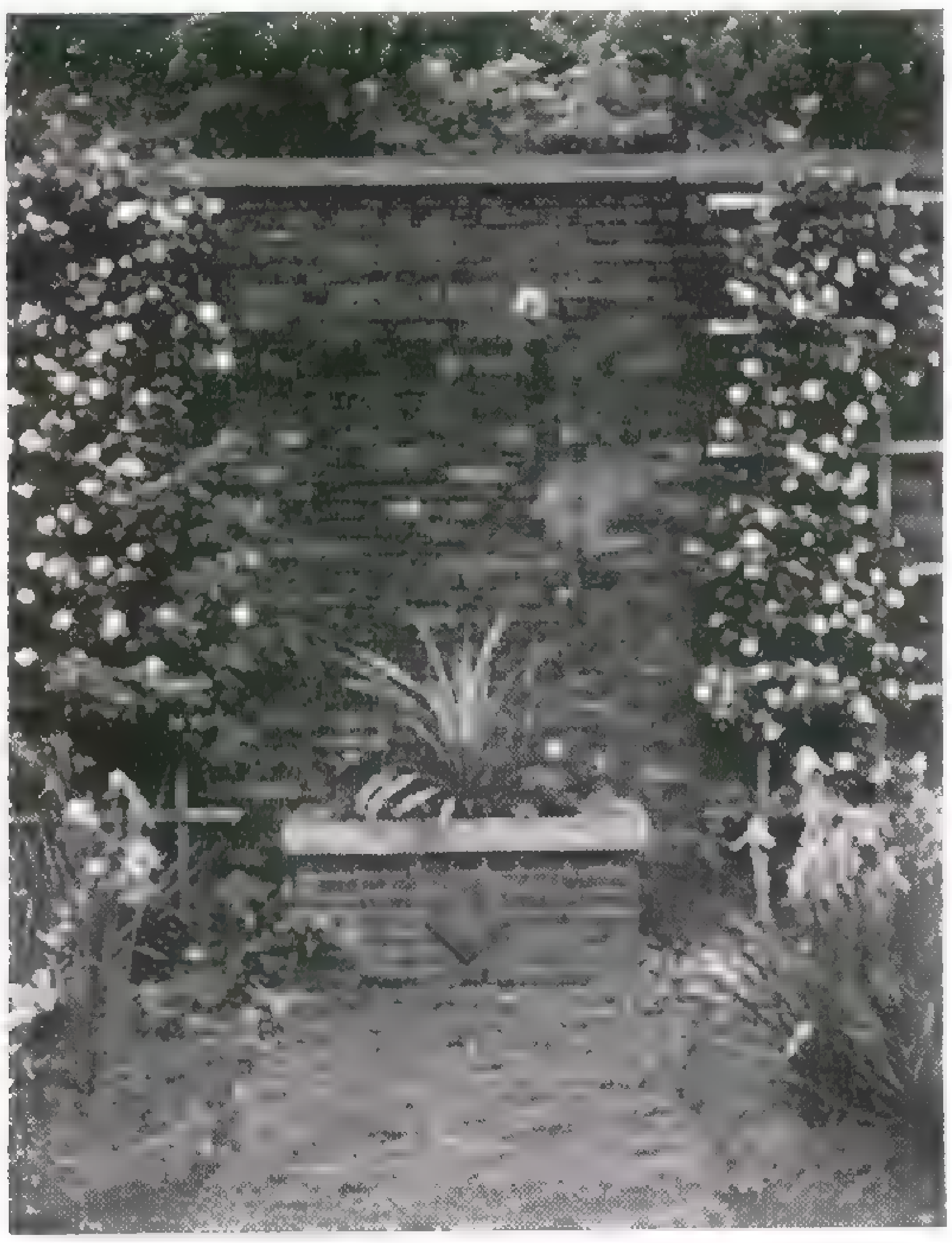
It might be well to pause for a moment in the discussion of pruning to say a few words about the pruning tools. The pruning shears are used more than any other tool. It should be strong, made of good steel, and may be either single-edged or double-cut. To cut canes a half inch or more in diameter, a pair of lopping shears, with 24-inch handles, is the proper tool. Climbing roses are thorny and have a nasty way of catching in clothing. The lopping shears will be found indispensable in picking up long and unruly canes and dragging them away. When the crowded condition of the stems makes it impossible to cut heavy basal canes with lopping shears a key-hole saw is the tool to use.

In pruning rambler roses almost all the canes which bore flowers in June should be removed. There will be many new canes at the base of the plants to replace them. Such treatment seems drastic, but it is surprising how fast the new shoots grow. Before pruning, all of the canes should be removed from the trellis and laid on the ground. The old canes are then severed at the base and the new ones tied in place. When the ramblers are badly tangled, the old canes must be cut away in sections. It may be stated at this point that if rose canes have been tied to one side of the trellis, instead of being woven between the bars, it is much easier to remove them before pruning. Ramblers on large arches or trellises are not pruned so severely.

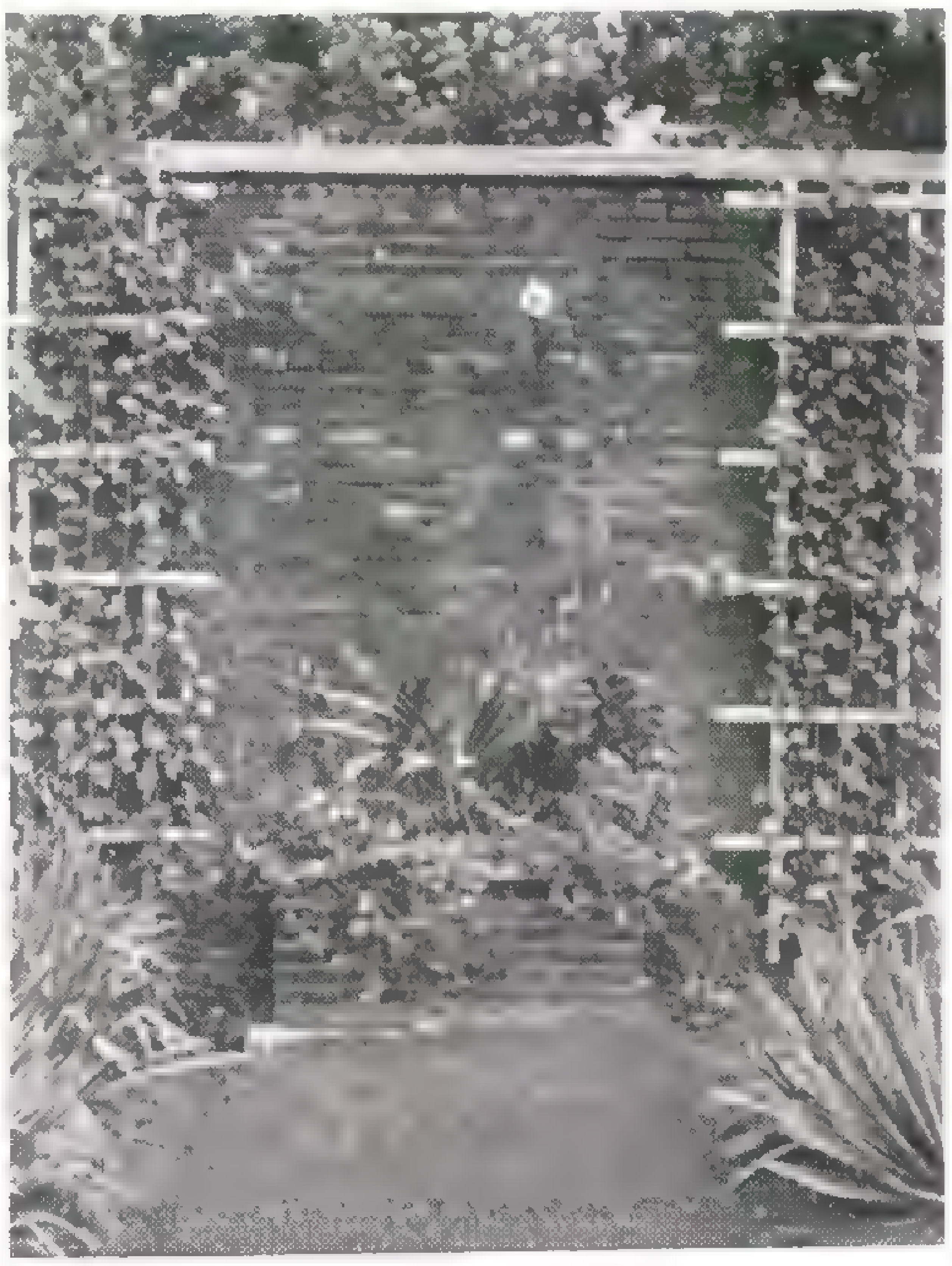
Propagating Roses.—A great deal of the interest and fascination of growing roses is centered in their propagation, and nearly all rose-growers prac-

GOLDEN CLIMBER "MRS. ARTHUR CURTISS JAMES"

CLIMBING ROSE "AMERICAN PILLAR"



CLIMBING ROSE IN BLOOM IN MAY, "ALIDA LOVETT"

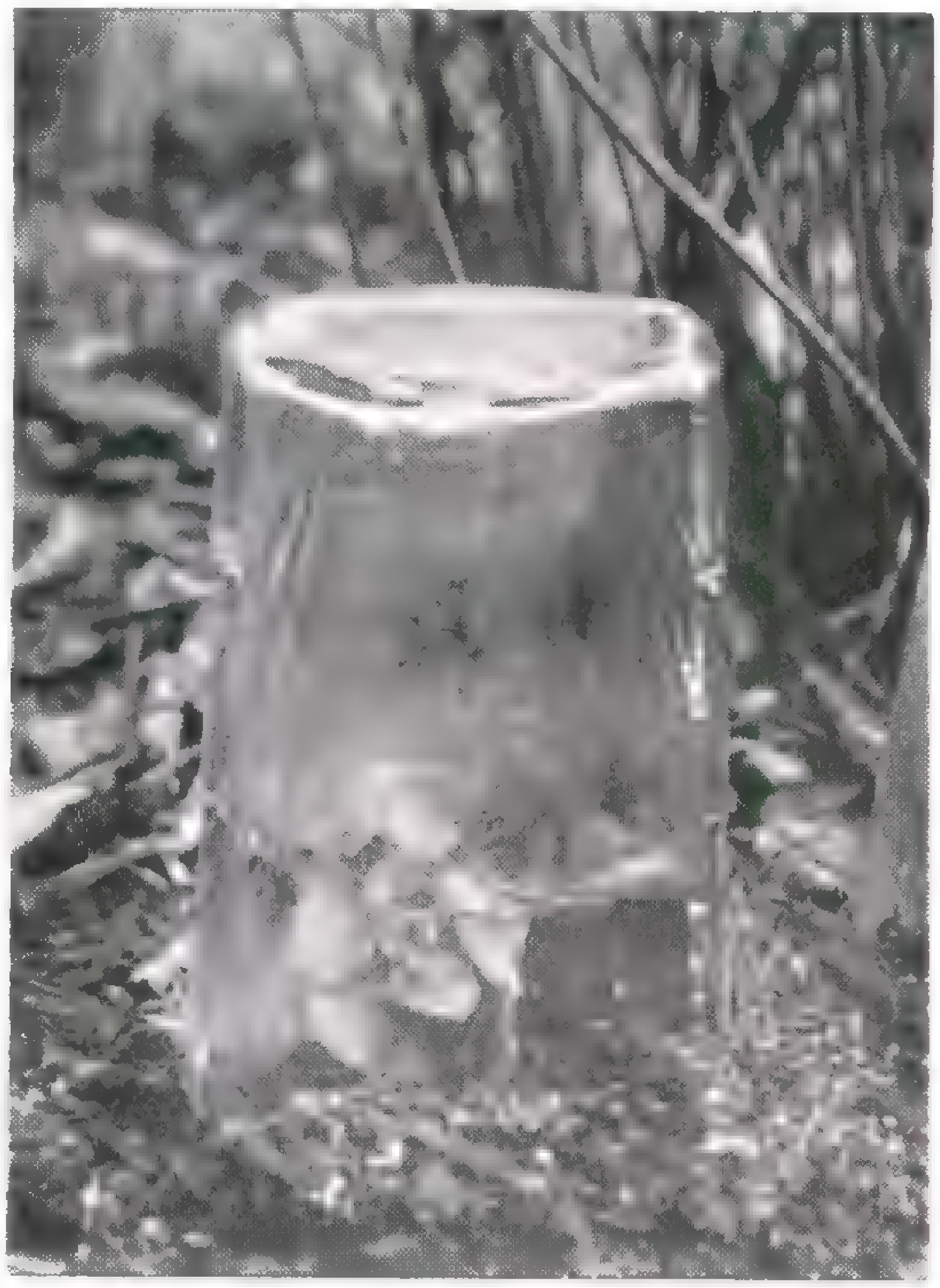


"ALIDA LOVETT" AFTER BEING PRUNED IN JULY tice it with varying results. Some of the climbing, polyantha, and strong-growing bush roses thrive as well on their own roots as do the budded plants. Many of these roses are rooted by the popular Mason-jar method. The cuttings are usually made in the autumn from blooming wood. About three inches of the stem immediately beneath the spent flower is cut away, the next six inches of wood yielding a good cutting. The basal cut is made immediately beneath a bud. Remove all leaves except the upper two or three. A rose leaf is a compound leaf, each leaf usually being composed of five or seven leaflets. When it is said that all of the leaves, except the upper two or three, should be removed, the statement refers to the compound leaves and not to the leaflets. Several additional cuttings can usually be made from the same stem. These cuttings are inserted at least two inches deep in light soil and covered with a glass jar pressed into the soil. When colder weather occurs some additional soil is heaped around the base of the jars. The cuttings may be placed in a spot where the rose bush is to grow or they may be started in a specially prepared bed and transplanted a year later. They are kept under the jar during the fall and winter but in late April or May they are gradually hardened by removing the jar a few hours each day.

Roses may also be grown from cuttings made in June, or August and September. Such cuttings are made three to four inches long, from firm, twiggy wood, with one leaf at the top. Rooting can be hastened and improved by first dipping the cuttings in one of the root-forming chemicals. Moisten the end of the cutting, shake off the water, dip in the hormone powder, tap the cutting on the edge of the container to remove the surplus powder, and then insert it in the rooting medium with a dibber. Summer cuttings are inserted in flats or pans of sand and placed in a cool and shaded spot. Meramec sand packs tightly and does not need as much water as the coarser Mississippi River sand. Spray the cuttings several times a day the first two weeks and always shield them from the wind with cloth or paper. After the third week some varieties will have rooted, and these are potted when the roots are at least an inch long. The most recent medium in which to root cuttings is vermiculite. The grade best suited is sold under the trade name "Terra-Lite." It is sterile, very light weight, retains a great deal of moisture, yet drains well. Try it and you can be assured of excellent results. Incidentally, there is no better material in which to sow seeds.

Climbing roses can be rooted by layering. This is done in early spring by bending some of the long canes to the ground and covering the bent sections with six inches of soil. A piece of wire, shaped like a hair pin, will hold the stem in place. The loose end of the cane is tied to a stake or the trellis. In March of the following year the cane is severed from the parent

Thin canes yield the best summer cuttings



Winter cuttings under glass jar

PROPAGATING ROSES

HILLING ROSES IN NOVEMBER

ROSES PROTECTED WITH PENNISETUM GRASSES

plant and set in its new location. Climbing roses will root more quickly if a cut is made half way through the stem and a small stone inserted in the cut surfaces before it is pegged down and covered. They also root easily from thin, but firm, greenwood cuttings.

Winter Protection.—About mid-November the soil should be hilled up around the base of the hybrid tea roses, with the work completed by Thanksgiving. Soil from the border of the bed and from between the plants is used. This is the best way to protect hybrid tea roses, but additional protection can be given when material is available. Baled straw is useless as most of it is too short. Excelsior is fairly good; ornamental grasses, both annual and perennial, furnish good mulching material; and oak leaves can be used if held in place with chicken netting. In late November the plants are given a winter mulch to shield them against the wind and the sun. Polyantha, hybrid perpetual, and climbing roses pass through normal winters without the additional mulch. Roses should not be uncovered too soon in the spring. Warm weather in February will induce the buds to swell, but each year these spells are followed by a freeze. Winter mulches are removed when the roses are pruned in late March or early April.

Spring Pruning.—All roses require some pruning each year. Polyantha roses should have the weak wood and some of the older canes removed. The remaining stems are cut back to about a foot.

Hybrid tea roses receive the most pruning. In severe winters much of the wood is frozen as far back as the mulch, but varieties differ in their hardiness. When grown for garden display they should be moderately pruned. Three to six canes are left to each plant and these are pruned to twelve to twenty-four inches, the cut being made above an outside bud. Frozen wood is shriveled and brown but sound wood is green and the buds are plump.

Most of the new canes of the hybrid perpetuals grow from the base of the plants after the blooming period. Some of these canes grow six feet tall. At whatever height they are pruned in the spring, the flower-bearing laterals will develop near the top. The number of flowers of the hybrid perpetuals can be increased by tying the long canes horizontally. Most of the old flowering canes are removed during the summer.

When pruning rugosa roses examine them closely, as they frequently are infested with scale. Single rugosa roses are pruned to a height of three or four feet and the hybrid rugosas to four to five feet. Shrub roses should always have the wood removed at the base.

Rose varieties.—In answer to the many requests the Garden receives for names of suitable roses for this locality the following partial list has been compiled:

HYBRID TEA ROSES

Ami Quinard—single and semi-double, velvety crimson.
Betty Uprichard—salmon-pink and coppery carmine.
Briarcliff—deep rose-pink.
Charlotte Armstrong—red.
Countess Vandal—coppery bronze.
Crimson Glory—rich red.
Dicksons Red—red.
Duchess of Wellington—golden-orange and salmon.
Eclipse—yellow.
Edith Nellie Perkins—pink.
Etoile de Hollande—red.
Girona—multicolored.
Margaret McGredy—carmine-rose.
Mirandy—red.
Mme. Jules Bouche—white.
Mrs. Charles Bell—shell-pink.
Mrs. Erskine Pembroke Thom—yellow.
Peace—yellow, edged pink.
Radiance—pink.
Red Radiance—red.
Rubaiyat—red.

POLYANTHA AND FLORIBUNDA ROSES

Betty Prior—pink.
Chatillon Rose—bright pink.
Floradora—orange-pink.
Gruss an Aachen—mixture of pink and salmon-yellow.
Holstein—red.
Kirsten Poulsen—light red.
Lafayette—cherry-crimson.
Mrs. R. M. Finch—pink.
Pinocchio—pink and salmon.

CHINA ROSES

Green Rose—a curiosity.
Hermosa—soft pink.

HYBRID PERPETUAL ROSES

American Beauty—pink and carmine, very fragrant.
Baron de Bonstetten—velvety crimson, very fragrant.
Captain Hayward—deep pink, moderately fragrant.
Clio—pale pink, fragrant.
Frau Karl Druschki—white, scentless.
Georg Arends—soft pink, fragrant.
Mrs. John Laing—clear pink, moderately fragrant.
Paul Neyron—rose-pink, moderately fragrant.
Prince Camille de Rohan—dark crimson, fragrant.

HYBRID PERPETUAL "FRAU KARL DRUSCHKI"

HYBRID TEA ROSE "FAIENCE"

FLORIBUNDA ROSE "SNOWBANK"

SHRUB ROSE "HARISON'S YELLOW"

RUGOSA ROSES AND HYBRIDS

Agnes—coppery yellow, fragrant.
Conrad Ferdinand Meyer—light pink.
F. J. Grootendorst—small, fringed, bright-red flowers.
Hon. Lady Lindsay—yellow and pink.
Nova Zembla—white, tinged pink.
Pink Grootendorst—pink.
Rosa rugosa alba and R. rugosa albo-plena—single and double, white rugosas.
Sarah Van Fleet—rose-pink.
Vanguard—orange-salmon.

SHRUB AND SPECIES ROSES

Blanche Moreau—moss rose, white, tinged pink.
Crested Moss—moss rose, rose-pink.
Harison's Yellow—Scotch rose, yellow.
Rosa Hugonis—yellow shrub rose.
Penelope—hybrid musk rose, shell-pink.
Rosa setigera—a native pink rose.

TRAILING ROSES

Max Graf—pink.
Rosa Wichuraiana—white.

CLIMBING ROSES

Large-Flowered Varieties:

Alida Lovett—double, shell-pink.
Bess Lovett—semi-double, crimson-red.
Blaze—semi-double, red.
Christine Wright—semi-double, bright pink.
Climbing American Beauty—double, carmine.
Doubloons—double, yellow.
Dr. W. Van Fleet—double, flesh-pink.
Jacotte—semi-double, apricot.
Mary Lovett—semi-double, bright pink.
Mary Wallace—semi-double, bright pink.
Mrs. Arthur Curtiss James (Golden Climber)—semi-double, yellow.
Paul's Scarlet Climber—semi-double, red.
Purity—semi-double, white.
Roserie—double, deep to light pink, thornless.
Silver Moon—semi-double, white.

Small-Flowered Varieties:

American Pillar—single, scarlet with white center.
Dorothy Perkins—double, pink.
Evangeline—single, soft pink.
Excelsa—double, deep rose-pink.
Ghislaine de Feligonde—semi-double, apricot-yellow.
Gruss an Freundorf—semi-double, dark crimson.
Hiawatha—single, carmine with white center.
Wartburg—semi-double, deep pink.
White Dorothy—white.
Wichmoss—moss-covered buds, semi-double, bright pink.

A TRIBUTE

An unsurpassed record of continuous service to the Board of Trustees of the Missouri Botanical Garden terminated January 22, 1947, with the resignation of Judge George C. Hitchcock as Trustee. It is a privilege for the members of the staff to acknowledge and honor his unselfish devotion to this institution, conceived and endowed by Henry Shaw, by recording below a resolution unanimously passed by the Trustees at a meeting of the Board held on February 19, 1947.

RESOLUTION

When a man who has served for nearly half a century as a faithful member of a Board of Trustees wishes to retire, it calls for something more than a perfunctory resolution. When the same man serves with distinction as President of this Board for eighteen years and determines to resign it would seem to call for something more than a mere record in the minutes. But when that man is George C. Hitchcock, resolutions and minute recorded motions are the most that he will permit and even these are possible only because he is not present at the meeting.

Mr. Hitchcock was elected a Trustee of the Missouri Botanical Garden on November 11, 1903, to fill the vacancy caused by the death of Joseph Branch, one of the original Trustees named in the will of Henry Shaw. He was elected President of the Board in March, 1928, to succeed Mr. Edward C. Eliot, who died in office. A notable record simply in years of service, but when these years stand for unremitting devotion to, and intelligent guidance of, the affairs of the Henry Shaw Estate, it is something "seldom equalled and never excelled." Without reservation, the members of the Board testify that never did he fail to give the time and skill necessary to carry on successfully the duties of his office. He was true to the trust imposed upon him.

The Board of Trustees of the Missouri Botanical Garden record, with sincerity, their appreciation of the many services rendered by Judge Hitchcock, their President, and deeply regret the necessity of terminating the happy and helpful association enjoyed these many years. We shall miss him both as Trustee and Presiding Officer, and wish him many more years of sustained usefulness both to his friends and his community.

Mr. Richard J. Lockwood has been elected President of the Board succeeding Judge Hitchcock, and Mr. Henry Hitchcock has been elected Trustee to fill the vacancy created by the resignation of Judge Hitchcock.

The Red Buckeye is a native of Missouri, though confined to the swampy woods of its southeast corner. Its brilliant red flowers make an attractive display in low woods after the spring wild flowers have passed. It is doing well at the Arboretum near the west bridge.

Missouri's limestone glades have a large, clean-looking plant of the Parsley family which blanches to a straw-white after it has flowered and set its seeds. It is known as "Prairie Parsley" or "Glade Parsley" and its scientific name is *Polytaenia Nuttallii.*

NOTES

Mr. Ladislaus Cutak, in charge of Succulents at the Garden, spent about six weeks on a collecting trip in Mexico during February and March.

Mr. Robert B. Clark resigned his position of Arboriculturist at the Garden, March 1, to accept an assistant professorship at New Jersey Agricultural College, New Brunswick.

Recent visitors to the Garden were: Mr. Clarence Chase, of the Chase Gardens, Portland, Oregon; Mr. Rodney I. McLellan, of the E. W. McLellan Co., Wholesale Flower Growers, San Francisco, Calif., and Mr. John Hager, orchid grower for the firm.

The spring flowering season at the Arboretum began this year on March 9, when one of the early crocuses *(Crocus Tomasianus)* at the Trail House came into bloom within two feet of a lingering snow bank. Crocuses were occasionally observed in flower at the City garden during warm spells in January and February but not again until March 14 at which time snowdrops were also seen.

The first number of volume XXXIV of the ANNALS OF THE MISSOURI BOTANICAL GARDEN was recently issued, with the following contents: Northern Flint Corns, William L. Brown and Edgar Anderson; *Mycocandida riboflavina,* Carroll W. Dodge; Inheritance in the Carnation *(Dianthus caryophyllus)*. III. Inheritance of Flower Color, Gustav A. L. Mehlquist and T. A. Geissman.

Among the visitors to the Garden library and herbarium during the month were: Dr. Carl Epling, professor of botany, University of California, Los Angeles; Dr. Martha Springer, Curator of the Herbarium and Instructor in Botany, University of Indiana; Dr. Wm. L. Brown, Geneticist, Pioneer Hi-Bred Corn Co., Des Moines, Iowa; Mr. Irving F. Ahlquist, of the department of history, University of Illinois; Mr. Edgar L. Evinger, of the Republic Chemical Corporation, New York City; Dr. A. C. Smith, Curator of the Herbarium, Arnold Arboretum of Harvard University, Jamaica Plain, Mass.; Dr. Julian A. Steyermark, Assistant Curator of the Herbarium, Chicago Museum of Natural History (Field).

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

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MISSOURI BOTANICAL GARDEN BULLETIN

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Missouri Botanical Garden Bulletin

Vol. XXXV APRIL, 1947 No. 4

THE PERFECT WEED

RICHARD HOLM AND DENISON MOREY

Of all the weed plants found in the United States the dandelion is perhaps the best known and the most disliked. It would certainly have suffered extermination long ago if it were not for a persistence and vitality almost unequalled by any other plant. Yet such are the remarkable devices that it employs in its struggle against adversities, especially man, that as weeds go the dandelion has no close competitor. Even a brief study of the biology of the dandelion reveals facts about its home life that cannot help but create admiration for its ingenuity and resourcefulness. The processes of natural selection seem to have made of this plant a composite of weed perfection. To begin with, the plant is nearly always a rosette of ground-hugging leaves—a habit of growth which renders it more or less inaccessible to lawnmowers and to the dangers of cutting and compression in general. The rosette is formed by the internodes (the parts of the stem between the leaves) being greatly shortened so that the leaves appear one right above the other. The dandelion has all the parts of any normal plant but with the stem highly telescoped.

Since the dandelion is a strong perennial which comes up year after year with distressing regularity one may wonder how it manages to keep hugging the soil, for, after all, the stem and roots must grow a little each season. There are two methods that the dandelion uses to maintain the rosette habit. The first is by the roots which in this plant are no ordinary structures. Throughout the year certain cells in the roots are undergoing contraction so that the plant is literally pulled down into the earth (fig. 1). Contractile roots are not limited to dandelions by any means, but here they are employed to produce a type of growth habit that is particularly useful to a weed. The second method is called crown-cloning. This simply means that the stem produces many branches which grow vigorously sideways. If these branches should become separated from the parent plant by cultivation or though death of the parent, each will form an independent plant. Since no sexual reproduction is involved, the plant is merely producing replicas of itself which have exactly the same heredity. Inspection of a patch of dandelions will show that each plant is surrounded by a group of identical satellites. There is another way that this situation may arise which will be discussed later.

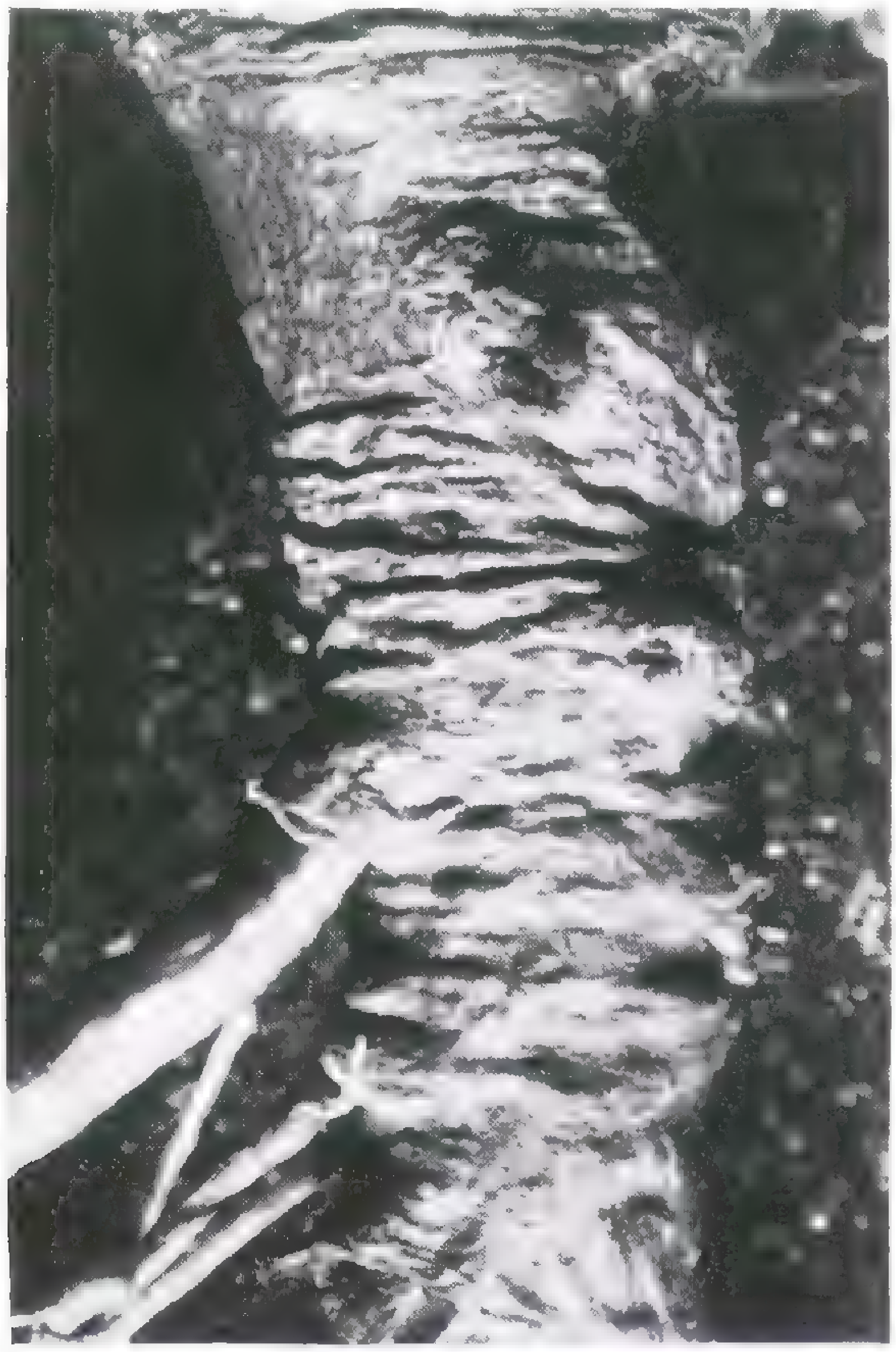

Fig. 1. Root of a dandelion showing wrinkling caused by contraction of cells in the cortex. About twice natural size.

These examples are but hints of the dandelion's cunning. After this, we are prepared to accept the appearance of many weird, but extremely efficient, devices for self-preservation. One of the most intricate is found in the manner in which the plant flowers and ripens its seeds. First, however, let us consider something of the dandelion's "flower". The flower of the dandelion is really made up of many individual flowers, each of which has a seed and all the other parts which make up an ordinary blossom. This is in itself an efficient reproductive device in that many seeds are produced, whereas a single flower of like construction would produce only one seed.*

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* There are about 300 seeds to a dandelion head.

When the dandelion blooms it behaves in a manner that seems unconventional (fig. 2). Ordinarily, flowers borne in an upright position would be destroyed by the lawnmower some time between flowering and seed dispersal. But the dandelion seems to be aware of the fact that people mow their lawns more or less intermittently and sticks its neck out only when necessary, pulling it in during the period of seed maturation. When the flower head is ready to open, the scape (flower stem) elongates somewhat. After all the flowers in the head have matured, it closes and the scape grows in such a way that the flower head reclines on the ground. The seeds mature while the inflorescence (flower head) is nestled snuggly

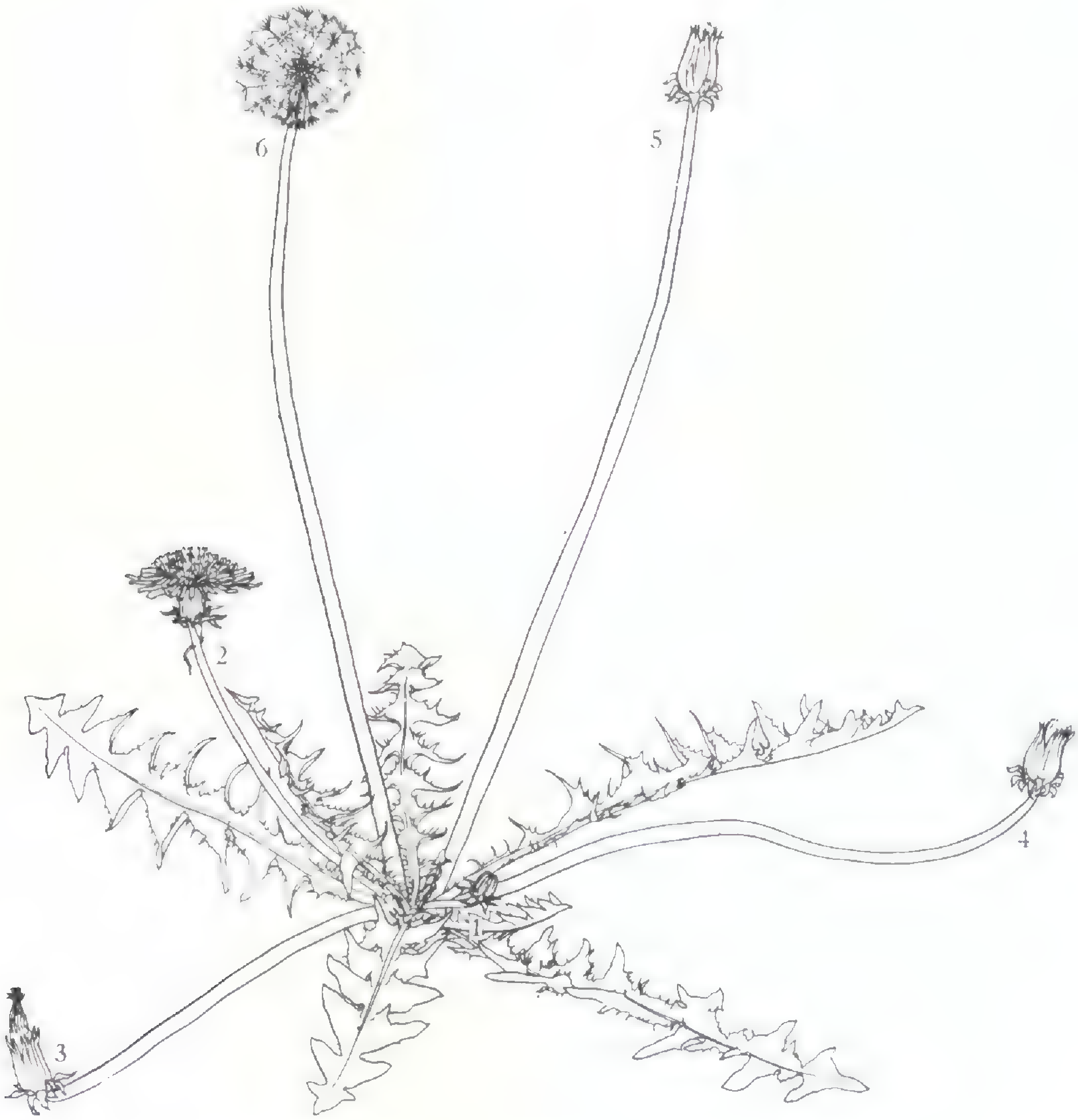

Fig. 2. A dandelion plant showing various stages in the development of the seed-heads: 1, a young flower bud; 2, the scape at maximum flowering length; 3, the scape after flowering, shown resting on the ground; 4, the scape rising up again; 5, a fruiting scape at maximum elevation; 6, the same shedding seeds.

in the surrounding grass. In the meantime the lawnmower is buzzing harmlessly over its head. When the seeds are mature the scape suddenly elongates to an amazing length and carries with it the head of ripened seeds, each of which, equipped with a parachute of white hairs, blows away.

The dandelion seed itself is a wonderful thing. When once blown free of the head, it is propelled upon the slightest breeze. Examination shows that it is composed of three parts: the seed itself (the achene), the pappus (the fine white hairs), and the beak (a slender stalk connecting the pappus with the achene). The engineering principles of the seed's dispersal mechanism are aerodynamically perfect. The achene being the heaviest part keeps the pappus in a generally horizontal plane so that all upward drafts of air will have maximum effect. The beak, however, is the most interesting part of the apparatus. One must look closely for it, because it is only a sixteenth of an inch long at this time. When the seeds have matured and shortly before the head is to reopen, the beak begins a spurt of growth, finally reaching a length of half an inch or so. The dandelion certainly seems to have timed everything perfectly.

The movements that the dandelion goes through to send up a flower head have already been described. It seems, though, that pollination is but a "memory" to the plant. All the dandelions common as weeds in the United States have "set" seed before the flower opens. This condition, known as apomixis, is a device for eliminating sexual reproduction. The normal parts of the flower are all there, and pollen may or may not be produced. Even though the tip of a bud is cut off with a sharp razor, right down to the pappus, and the stamens and pistil removed, the plant goes right ahead and produces seed as if nothing had happened. Perhaps in the course of time flowering will be eliminated as it has been in some violets and other plants.

It is obvious that if the seeds of the plant are formed before the flowers open, they will receive hereditary factors only from the mother. Since nothing but some change in the heredity of the mother can alter the characteristics of the offspring, this is essentially the same as the crown-cloning mentioned previously. It is not very different either from ordinary vegetative reproduction or regeneration in which the dandelion excels.

The superior capacity for regeneration exhibited by the dandelion is obvious to anyone who has spent long hours trying to dig them out of his lawn. His toil is rewarded only by an exceptionally abundant crop of new rosettes later on. It wouldn't be quite as bad if the root would form only a single new rosette but instead it seems to be driven by a vengeful spirit to regenerate many new crowns to replace the one which was so laboriously removed. The result is, that unless the entire plant is removed, root and all, it will recover and appear healthier and in greater numbers than before.

Despite its ingenuity, the plant is destined to a harsh fate in the very near future. Dow Chemical Co.'s 2-4-D is exceptionally effective against dandelions. This and other weed killers, weapons of man in his never-ceasing campaign to rule his environment, predict the nemesis of the dandelion as a lawn weed. To be sure, this will be a continuous battle because even though all the dandelions in our lawns are killed yearly, there probably always will be a reservoir of seed sources in vacant lots and fields. The dandelion may even develop a resistant strain which the weed killer will not affect. However, at present, 2-4-D sprayed on the leaves and down into the crown of a dandelion plant kills it, root and all.

Tephrosa virginiana.—

One of the most conspicuous wild-flowers in Missouri, *Tephrosa virginiana,* is not familiar to many St. Louisans because it grows only in certain types of soil. In the neighborhood of St. Louis it is chiefly confined to cherty oak-hickory ridges where for centuries rains have dissolved the original limestone and carried it away, leaving behind the hard flint or chert which produces a soil with an acid reaction. In these dry ridges Tephrosa is very much at home, producing great bunches of feathery gray-green foliage about knee high, above which the panicles of flowers are borne in great profusion. The individual flowers are like small sweet-peas and are a soft yellow-green brightly marked with magenta-purple. Seen against the soft gray-green of the foliage they are most conspicuous and one might suppose that they would have received a genuine common name. The books say they have one and mention "Goat's Rue" and "Cat-gut." In Missouri these seem to be merely book names and a good honest local name for this attractive and interesting plant has yet to come forth.

During the war Tephrosa caused quite a flurry in some circles when it was reputed to have a high rotenone content. In Missouri the spots where it grows readily are not suitable for cultivation but in the East it is equally at home in sour sandy soils, and there it might possibly become a useful crop plant if there was a sufficient demand for it.

Amateurs often bewail the fact that beautiful wild flowers are given strange and ugly scientific names. Almost equally annoying is the way in which some awful weeds have fallen heir to really lovely designations. Our Ragweeds, for instance, all go in the genus *Ambrosia*! The European species, which were the first to receive the accolade are said to be more deserving than their American cousins.

BROAD-LEAVED EVERGREENS FOR ST. LOUIS AND VICINITY

ROBERT B. CLARK

The problem of furnishing the garden in winter so that interest does not languish with the falling of the leaves may be solved by the introduction of broad-leaved evergreens. Not especially noticeable during the summer months, these plants provide masses of greenery in the gray winter landscape. Some have glossy green foliage throughout the year; others assume hues of red or dark purple in winter; all are attractive at any season.

Broad-leaved evergreens, more than other types of plants in this area, require a little attention in the autumn. The preservation of moisture is of primary importance. Unlike deciduous plants, evergreens lose moisture in winter by transpiration through their leaves. An excessive loss of water can be alleviated somewhat by screening the plants from the drying winter winds and by mulching the soil around them with straw or other material that does not pack too tightly. In addition to mulching, they must be given copious amounts of water in the autumn. This is a small price for preventive maintenance compared with the large returns in satisfaction and winter greenery.

Since the broad-leaved evergreens are a rather heterogeneous horticultural group, we will consider them according to their habits and ultimate heights. There are ground-covers, dwarf edging plants, shrubs and trees, also shrubs that are semi-evergreen (that is, they retain their green leaves during part of the winter).

In the accompanying tables the first column after the common name lists the ultimate height which the plant attains while the next column refers to the foliage texture. (F signifies fine; M, medium or intermediate; C, coarse). The third column gives the general color effect of the flowers, while the next column indicates the months in which the plant blooms. The fifth column gives the color of the fruit, if attractive; the sixth column, the general soil preference, or when figures are given, the exact value in the "pH" system of denoting acidity or alkalinity. Finally, in the column showing tolerence of plants for shade—or at least partial shade—the letter "X" means that the plant will thrive in a location of light (not dense) shade, while "Sun" means that it prefers an open position in the garden.

GROUND COVERS

These plants may be vine-like, trailing over the ground and creeping onto trees and walls, or they may be dwarf shrubs that form dense mats. They find use in rockeries, on steep slopes, and in shady places where other plants will not survive. Notable in this group is the English Ivy, especially the Balkan strains introduced by the Garden two years ago which are "tailored" to withstand the hot dry summers and cold open winters of St. Louis and the Middle West. A detailed account of how these ivies were selected and important cultural notes are given in the BULLETIN, March, 1945. Another interesting plant is the Purple-leaf Wintercreeper whose foliage turns to dark reddish-purple or bronze in the fall and remains so until spring. Also included in this group is Hall's Honeysuckle which has escaped from cultivation in the South and has become a nuisance by clambering over other vegetation.

Botanical Name	Common Name	Foliage texture	Flower color	Season	Fruit color	Soil pH	Shade
Euonymus Fortunei colorata	Purple-leaf Wintercreeper	M	green	Ap	red	neutral	X
Hedera Helix, Balkan strains	English Ivy	C	green	S-O	black	6.0-8.0	X
Iberis sempervirens	Evergreen Candytuft	F	white	Mr-Ap	—	6.0-7.5	Sun
Lonicera japonica Halliana	Hall's Honeysuckle	M	white	Je-S	black	6.0-7.5	X
Lonicera sempervirens	Trumpet Honeysuckle	M	red	My-Au	black	6.0-7.5	X
**Pachysandra terminalis*	Japanese Spurge	M	white	Ap-My	—	4.5-5.5	X

* Requires special culture because of its preference for strongly acid soil

DWARF EDGING PLANTS

For edging walks or flower beds in formal gardens three evergreen shrubs are recommended: germander and two varieties of boxwood. The germander has a softer texture than the colder, more formal box. All withstand shearing and maintain a good appearance throughout the year. Information regarding the culture of boxwood appeared in the BULLETIN, March, 1944.

Botanical Name	Common Name	Height in feet	Foliage texture	Flower color	Season	Soil pH	Shade
Buxus microphylla koreana	Korean Box	1–2	F	yellow	Ap	6.0-8.0	Sun
Buxus sempervirens suffruticosa	True Dwarf Box	2–3	F	yellow	Ap	neutral	Sun
Teucrium Chamaedrys	Germander	1–2	F	purple	Au-S	sub-acid	Sun

EVERGREEN SHRUBS

In winter, evergreen shrubs not only provide accents and mass effects in the garden, but their attractively colored foliage adds decoration to the foundation planting. The leaves of the glossy Abelia, Oregon Holly-grape, and Laland Firethorn become richer with hues of dark reddish-purple when cold weather arrives. In spring and summer many of these evergreen shrubs are spectacular for their flowers; while the autumn fruit displays are also interesting. In the occasional severe winter some of these evergreens may be injured, but they usually recover in the succeeding growing seasons. Cultural notes for growing azaleas (and rhododendrons) in St. Louis are published in the BULLETIN, May, 1941.

Botanical Name	Common Name	Height in feet	Foliage texture	Flower color	Season	Fruit color	Soil pH	Shade
Abelia grandiflora	Glossy Abelia	3–4	F	pink	Je-O	—	6.0-8.0	
Berberis Juliana	Wintergreen Barberry	2–3	M	yellow	Ap	black	neutral	X
Berberis Sargentiana	Sargent Barberry	2–3	M	yellow	Ap	black	neutral	X
Berberis triacanthophora	Three-spine Barberry	2–3	M	yellow	Ap	black	neutral	X
Berberis verruculosa	Warty Barberry	2–3	M	yellow	Ap	black	neutral	X
Buxus sempervirens	Common Box	2–3	F	yellow	Ap	—	neutral	Sun
Euonymus Fortunei radicans	Common Wintercreeper	3–4	M	green	Ap	red	subacid	X
Euonymus Fortunei vegeta	Big-leaf Wintercreeper	2–3	M	green	Ap	red	6.0-7.0	X
Ilex crenata convexa	Box Holly	2–3	F	green	Je	black	5.0-6.5	Sun
**Ilex glabra*	Inkberry	4–6	F	white	My	black	4.5-6.0	X
Mahonia Aquifolium	Oregon Holly-grape	3–4	C	yellow	Ap-My	blue	6.0-8.0	X
Nandina domestica	Nandina	3–4	C	white	Je-Jy	red		X
**Pieris floribunda*	Mountain Andromeda	4–6	M	white	Ap	—	5.0-6.0	X
**Pieris japonica*	Japanese Andromeda	6–8	M	white	Ap	—	5.0-6.0	X
Pyracantha coccinea Lalandi	Laland Firethorn	4–6	F	white	Ap-My	orange	6.0-8.0	Sun
**Rhododendron carolinianum*	Carolina Rhododendron	2–3	M	pink	Ap	—	4.5-6.0	X
*†*Rhododendron catawbiense*	Catawba Rhododendron	4–6	C	red	My	—	5.0-6.0	X
**Rhododendron maximum*	Rosebay	4–6	C	pink	My	—	4.5-6.0	X
**Rhododendron mucronatum*	Snow Azalea	2–3	M	white	Ap-My	—	subacid	X
**Rhododendron obtusum amoenum*	Amoena Azalea	2–3	F	red	Ap-My	—	4.5-6.0	X
Viburnum rhytidophyllum	Leather-leaf Viburnum	2–3	C	white	My	black	subacid	X
Yucca filamentosa	Adam's Needle	1–2	C	white	My-Je	—	5.5-7.0	Sun
Yucca glauca	Soapweed	1–2	C	white	My-Je	—	subacid	Sun

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* Require special culture because of their preference for strongly acid soil.

† Of the numerous hybrids of the Catawba Rhododendron, the following can be grown in this vicinity: Album Grandiflorum, Atrosanguineum, Boule de Neige, Caractacus, Catawbiense Album, Ignatius Sargent, Lady Armstrong, Mrs. Charles S. Sargent, Purpureum Elegans, Purpureum Grandiflorum, Roseum Elegans.

EVERGREEN TREES OR LARGE SHRUBS

There are only two large evergreen shrubs or small trees for St. Louis: the American Holly and the Bull Bay, and even the latter is considered not entirely hardy.* However, there is a good 12-foot specimen of the Bull Bay in the Garden at the north end of the iris garden. In winter and early spring its coarse, dark-green, leathery leaves are quite badly discolored, but the shrub persists. The American Holly, on the other hand, is perfectly hardy and grows into a beautifully proportioned shrub from 12 to 20 feet high. It must be borne in mind that hollies have separate sexes on each plant and therefore must be planted in groups to insure fruit production.

Botanical Name	Common Name	Height in feet	Foliage texture	Flower color	Season	Fruit color	Soil pH	Shade
Ilex opaca	American Holly	12–20	M	green	Je	red	5.0–6.0	X
Magnolia grandiflora	Bull Bay	12–20	C	white	Je-Au	red	5.0–6.0	X

SEMI-EVERGREEN PLANTS

As a class the semi-evergreens vary according to the region in which they grow. In the St. Louis area there are a few plants which provide green foliage during at least part of the winter but which are deciduous farther north. The semi-evergreens are useful in striking a balance between the barren twigs of deciduous plants and the full masses of evergreens. The Mentor Barberry and Spreading Euonymus are suitable for hedges. The Memorial Rose is good for ground cover over steep banks, or for climbing on arbors and trellises. The hardy bamboos, of course, are treated as perennials and are cut back to the ground each spring. The Glossy Cotoneaster may be sheared for screen plantings and for hedges, but the natural shrubby effect is very pleasing.

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* Since the article on "Magnolias" in the February BULLETIN appeared the author's attention was invited by Mr. Walker Hill to a magnificent specimen of *Magnolia grandiflora* var. *lanceolata* growing in the garden of Mrs. Paul Brown, 5585 Lindell Bl. This plant, which has attained a conical shape, now exceeds 15 feet in height. The leaves of the tree are larger than those of the Garden specimen (which is the species *grandiflora* that does not reach the elegant proportions of the variety). Despite all that has been written in favor of the hardiness of the Bull Bay, there are no records to substantiate its hardiness in this latitude. St. Louis is situated several hundred miles north of its native habitat, and during a severe winter one can expect both the species and the variety to succumb. Until that time, however, we can enjoy its loveliness.

SEMI-EVERGREEN PLANTS

Botanical Name	Common Name	Height in feet	Foliage texture	Flower color	Season	Fruit color	Soil pH	Shade
Berberis mentorensis	Mentor Barberry	3–4	M	yellow	Ap	red	neutral	X
Cotoneaster foveolata	Glossy Cotoneaster	6–8	C	pink	My	black	neutral	Sun
Euonymus kiautschovica	Spreading Euonymus	4–6	C	green	Je	red	subacid	X
Phyllostachys aureosulcata	Hardy Bamboo	6–8	M	white	Jy-Au	black	subacid	Sun
Pseudosasa japonica	Metake (Bamboo)	3–4	C	—	—	—	subacid	Sun
Rosa Wichuraiana	Memorial Rose	Trailing	M	white	Je, S	red	6.0-7.0	Sun

One of the strangest plants in Missouri is the Water Willow, *Dianthera americana*, which grows in shallow waters, often near a riffle in such places as along the Big River and on the upper reaches of the Meramec. It advances into the stream, anchoring itself among the rocks and oftentimes makes large patches of feathery foliage. Its curious and complicated blue flowers are borne for only a short period in early summer, to be followed by the seed-pods. The seeds, tiny disks of greenish-brown, look more like a small pill than a real seed.

The Golden Aster (*Chrysopsis camporum*) is a brilliant wild flower which has never caught the attention of the general public. There is a fine display of it every fall at the eastern edge of Pacific, Missouri, along U. S. Highway 66. There it flowers in great profusion at the foot of the bluff named in honor of the late L. P. Jensen, formerly Superintendent of the Garden Arboretum.

Triosteum perfoliatum is a rank weed and the books say that its common name is Horse Gentian. Perhaps it is, but few of the general public ever have any designation for this curious plant. The inconspicuous flowers are followed by tiny reddish-orange fruits which are borne tightly against the stem at the base of the leaves. Country children sometimes use them for doll-sized oranges when playing store.

The little Tenby Daffodil (*Narcissus obvallaris*) gave a good account of itself this year at Gray Summit. While all the other varieties in the collection were very much retarded by the cold spring, this variety was only a little later than usual and came into flower as soon as FEBRUARY GOLD, which in some seasons precedes it by a week or so. The Tenby Daffodil is small, of great perfection of form for a wild daffodil, and is bright gold.

ALONG THE HIGHWAYS AND BYWAYS IN SOUTHERN CALIFORNIA

LADISLAUS CUTAK

Winding, twisting trails wander into the desert, leading to picturesque canyons in the pastel-colored hills and to rocky eminences, through meadows of lush wild flowers, where all petty problems of a confused world are left behind. Mother Nature has either enlivened the countryside with brilliant splotches of color or subdued it with more somber tones. There is no denying that the plant life of the California deserts is as varied as the topography.

In southern California there are two outstanding deserts: the Mohave and the Colorado. Unlike the deserts of the Old World, these support an unbelievable array of fascinating native plants and immigrants. More than 700 species of flowering plants have been recorded, and it is probable that many more will be added when a more thorough study of the regions is made.

Roughly speaking, the Mohave Desert embraces all that area bounded by the Tehachapi Mountains and the southernmost extension of the Sierra Nevadas on the west to the Colorado River on the east, and from the San Gabriel, San Bernardino, and Chuckwalla mountains on the south to the unbroken deserts of southern Nevada on the north. In ancient times this vast terrain held a series of deep lakes. On the other hand, the Colorado Desert, or at least the main part of it, is composed of a single basin, the Cahuilla Basin, in which the Salton Sea is a prominent feature. As generally defined now, this desert includes the area between the San Ysidro Mountains on the west and the Colorado River on the east, and from the San Bernardino and Chuckwalla mountains on the north across the international boundary line into Baja California. The most distinctive plant of the Mohave Desert is the Joshua Tree, *Yucca brevifolia,* while the Sentinel Palm, *Washingtonia filifera,* is characteristic of the Colorado. The writer took advantage of an opportunity, early in 1946, to explore both of these deserts, along with many outlying districts rich in botanical features. It was thought worth while to pass on some of the experiences to our readers who may be contemplating a trip to southern California in the near future.

While a guest at the home of Dr. and Mrs. Frank Cariss at La Cañada, Mrs. Cariss drove me to many interesting near-by places. Their beautiful ranch-house is built on semi-desert land at the foot of the picturesque San Gabriel Mountains, bordering Arroyo Seco, one of the turbulent watercourses of years gone by. Conspicuous on the dark green mountain slopes were clusters of the tufted *Yucca Whipplei,* one of the most striking of desert lilies when in bloom. Some of the plants were already pushing up slender spires of creamy flowers, but the season was still too early for their greatest display, which usually occurs in early June. Magnificent views were to be had on the Angelus Crest Highway as it ascended the dizzy heights. The mountainous terrain is broken by deep canyons, sheer precipices, and imposing peaks, which become snow-clad in winter. The verdure is very often dense and primeval-looking. Deer and coyote were seen on numerous occasions during our stay at La Cañada.

A few miles beyond the road which leads to the world-famous Mount Wilson Observatory or in the vicinity of the highway tunnel we came across *Sedum spathulifolium* on the steep slopes and granite outcroppings. This stonecrop forms carpets of silver-green rosettes, some of them spangled with starry yellow flowers. Each rosette is composed of ten or more small spatulate leaves which have minute papillae (pimple-like protuberances) on both surfaces. One of its means of propagation is by runners (stolons) which arise on the thickened rootstocks just beneath the leaves, like the strawberry plant. It is often referred to as "Moss Sedum" because it prefers shaded moss-covered rocks and cliffsides. A close companion was a perennial species of Dudleya which sometimes grew right in the mats of Sedum and again in the crevices of perpendicular rock. It was found in dense shade and in full sun, but at no time were the single rosettes more than two inches broad. Dudleyas seem to be the most misunderstood group in the entire Crassula family, as a glance at the literature will reveal.

Joshua Tree (*Yucca brevifolia*), characteristic tree of the Mohave Desert.

Around the flats at La Cañada and in many other waste places of southern California, particularly along roadsides, were noticed many sprawly shrubs of *Nicotiana glauca,* the Tree Tobacco. According to Dr. T. H. Goodspeed, of the University of California, this plant, for many centuries, grew only in the foothills of the Andes in northwestern Argentina but man carried its seed in ships to many ports, and it has now become naturalized in various warm-temperate parts of the world. It has proven exceptionally adaptable in California. From the ends of branches clusters of long, slender-tubed, yellow-green flowers are suspended. A number of seedlings were brought back which we hope will become established in our Cactus House, along with other California desert plants.

Sentinel Palm (*Washingtonia filifera*), characteristic tree of the Colorado.

Another fascinating side trip was made to San Diego along the coastal highway, with a party composed of Florence Cariss, Maybelle Place, Charlie Place and myself. Within sight and sound of the Pacific surf we discovered on one slope most of the succulents that grow in the San Diego district. Here I first laid eyes on a hillside of glistening *Bergerocactus Emoryi.* I had seen this yellow-spined cactus in collections but when one comes upon it in its natural surroundings he experiences all the thrill that accompanies a rediscovery of a long-lost plant. This cactus is becoming rare in California, at least on the mainland. Though greatly resembling a typical cholla (cylindrical Opuntia), it really belongs to the Cereus group. It is a low, much branched plant with stout, cylindric stems almost completely hidden by the yellowish spiny armament. Generally, the stems are 5 to 10 inches long and curve upwards from the base as if to follow the contour of the hill upon which they grow. Fortunately, a few of the plants were still producing greenish blossoms although their season was just about over, at least in this area.

Along the Angelus Crest Highway, showing tufted *Yucca Whipplei.*

The Bergerocactus had three other relatives growing in association. One was *Mammillaria dioica,* a pincushion cactus which was quite plentiful, growing singly or in two and three heads. In the San Diego region all the plants examined were of the globose type, with firm, bluish-green tubercles and 12 to 14 slender, radiating, whitish spines, purple-brown at the tips. Usually there was only one central spine, which was longer and stouter than the others, hooked and brownish-black in color. Small, funnel-form, creamish flowers appeared at the top of each head. The second member of the group was *Ferocactus viridescens,* a Biznagita, or small barrel cactus, and it, too, was abundant. Being a much-depressed plant it was often hidden by clumps of grass. Most of the specimens were about 4 inches high

Bergerocactus Emoryi

and 6 inches broad, with 18 to 21 tuberculately irregular gray-green ribs. Its large areoles (areas from which the spines and flowers protrude) are felted and bear both radial and central spines, the latter 4 in number, very stout, compressed, yellowish-brown with rose-tinted bases. Many seedlings of various ages insured the perpetuation of this species on the hill. The Biznagita was in bloom, bright green flowers enwreathing the depressed center at the top. The last cactus collected was *Opuntia serpentina,* a prostrate or erect cholla with slender, bluish-green, prominently tubercled branches. Several yellow-brown spines are borne in each aerole which are usually covered with whitish to yellowish-brown papery sheaths.

Two other succulents were native to the hillside but there was still another which had its origin in Africa in the long ago. This is the common Ice Plant, *Mesembryanthemum crystallinum*, a member of the Fig-marigold family. It isn't a particularly showy species but is unique for the crystalline little vesicles that cover the entire plant and make it glisten in the sunshine. The two endemics were *Dudleya pulverulenta* and *Stylophyllum edule*. *Dudleya pulverulenta*, aptly dubbed "Chalk Lettuce," although rather scarce, was possibly the most outstanding of the entire group. It is densely covered with a white mealy powder which rubs off onto everything, like chalk. The leaves are generally oblong, rounded at the apex, with a rather abrupt triangular tip. *Stylophyllum edule* was plentiful. It has succulent, almost cylindric, greenish-blue leaves about 3 inches long.

In the same company, a more extensive trip of several hundred miles was undertaken to the wildest parts of the Colorado Desert. The first stop was Devil's Garden, in the Morongo Pass district east of Banning, which technically is a northwest arm of this desert. Our route led through rolling green hills to Beaumont and continued eastward into the famed Coachella Valley. On the outskirts of Banning, *Opuntia basilaris*, the Beavertail Cactus, bloomed along the roadsides. Near Whitewater, where a side-road leads to the famous winter resort of Palm Springs, our party scoured the stony foothills for the elusive Nipple Cactus, *Mammillaria phellosperma*. Around Palm Springs it is cylindric, up to 5 inches or more high, always solitary, nestling beside a rocky wash or half hidden under a bush. Numerous, long, bristly, silver-white radial spines nearly conceal the plant body. The 1–4 acicular, stouter centrals which emerge more or less horizontally from each aerole are hooked, yellow-white to light brown in the lower half, dark red to blackish toward the tips. In contrast to the cylindric form characteristic of the Colorado there is a globose variant found in the Mohave which very seldom exceeds 3 inches in height.

California's Barrel Cactus, *Ferocactus acanthodes*, was encountered for the first time in this region, but better stands were to be seen later. This Biznaga usually grows solitary, although two- and three-headed individuals were noticed infrequently and we did come upon a seven-headed specimen, which proves that anything is possible in this group. Straw-green flowers decorated the tops of many of the plants. Clumps of the Hedgehog Cactus, *Echinocereus Engelmannii*, were frequent, and starving *Opuntia Bigelovii* showed that rainfall had been scant. Another small cholla, apparently *O. echinocarpa*, and the odd Beavertail, *O. basilaris*, completed the cactus flora of our particular hill. A long, lance-leaved member of the

Crassula family, *Dudleya lanceolata*, was discovered here, with pinkish, flowering stalk and calyx and yellow-green corolla lobes. The plant is known as "Desert Savior" because the succulent leaves can be chewed for moisture during time of thirst. Some of the prospectors used to include it as a necessary item in their bag when traveling in waterless regions.

Around noon, Devil's Garden was reached, but we continued to Morongo Pass where lunch was eaten under the little shade offered by a spreading desert willow, *Chilopsis linearis*. This Bignoniaceous tree is an old favorite, having withstood eight winters in the St. Louis climate. In California it is confined to dry stream-beds where some moisture lingers to supply the hungry roots. Fortified with food and rested completely, we drove back to Devil's Garden—that weird expanse of rock and cactus where are congregated the most vigorous growths of *Ferocactus acanthodes* and *Opuntia Bigelovii*. The vegetable barrels are scattered everywhere, ranging from globose forms a few inches in height to bulky cylindric ones 3 and 4 feet tall and occasionally taller. The stout, ribbed stems are covered with strong rigid spines, very variable in color—anywhere from deep red to light pink or dull cream to yellow. The inner pulp of this cactus is saturated with moisture and can be sucked or chewed in dire necessity. Although the pulp is slightly puckerish at first it is not as unpleasant as some would have you believe. Experiments were conducted on three species of Ferocactus, and a detailed story of them appeared in the September 1946 BULLETIN.

Teddy Bear Cactus (*Opuntia Bigelovii*)

Bigelow's Cholla is the most vicious and spiniest of all our southwestern cylindric-stemmed Opuntias. The plants never spread over a wide expanse but seem to form dense colonies in restricted localities. Specimens averaging 2 to 4 feet are abundant. The main stem rises erect from the ground and the much-branched top forms a close head. The joints are short, turgid, and completely enveloped by glistening yellowish spines. They grow in such a fashion as to give the illusion of a jumbled mass of children's teddy bears, and "Teddy Bear Cactus" is the most common name for the plant.

Heading southeastward through the famed Coachella Valley, a productive date, alfalfa and cotton district, our next stop was beyond Indio at Valerie Jean's Date Shop, to refresh parched throats with cold date milk shakes for which this wayside stand is famous.

It is the contention of leading geologists that Coachella Valley, in the dim past, was the head of the Gulf of California, but when the silt-laden Colorado River dammed the narrow gulf with its residue it cut off the upper end and created an immense lake. The beach-line can still be clearly seen today high above the floor of the valley. The water disappeared from this ancient lake by evaporation, but time and again the lake bed has been partially refilled by the flood waters of the Colorado only to be slowly dried up. The most recent refilling occurred in 1905, at which time the present Salton Sea came into existence. It is a strange body of water because it is a sea below sea level, as well as being a salty one in the bed of what was once a clear-water lake.

Across from Valerie Jean's is the art and gem shop of John Hilton, well-known "desert rat" of Coachella Valley. Mr. Hilton has travelled through much of the desert on both sides of the border in search of rocks, gems, plants, and lore of the region. There are few places he has missed in southern California. Our purpose on seeing him was to obtain information about certain places which we had in mind to visit, the condition of the roads leading to them, etc.

Driving southeastward we skirted the entire west side of Salton Sea and then turned right on the Kane Springs-Julian highway to the rugged portion of the Borego Desert State Park. Before doing this, however, we stopped long enough to search for the peculiar sand concretions near where the Sandy Beach road turns off to Salton Sea. Wind and water have carved many strange forms in the sandstone concretion field, and we were able to imagine representations of birds, animals, nuts, pastry and other objects, in an endless variety.

The road to the Borego Desert led through dense stands of *Fouquieria splendens,* that shrub so characteristic of our southwestern desert. Its long, wand-like, thorny stems arise in clusters from a common root-crown and then at their tips bear showy racemes of scarlet-orange to scarlet-red tubular flowers. Many of the plants were at least 15 to 20 feet tall. In this exotic desert garden is an embryo townsite, Ocotillo, named for the dense forest of Fouquieria. The verdure becomes thicker and the scenery more enchanting as the road rises higher into the mountains. After crossing picturesque Sentenac Canyon in the dark a camping spot was located in a cove of trees near the southeast approach to Banner Grade. The canyon is named for Paul Sentenac, a French settler who lived alone at the head of the canyon opening into San Felipe Valley. Before retiring we had to anchor our blankets securely to the cots so that they would not be blown away during the night.

Beavertail Cactus (*Opuntia basilaris*)

Early in the morning we had to return to San Felipe Valley and take the Vallecito road to the Campbell Ranch, our objective in the Laguna Mountains. The road just reeks with romance, for the creaking coaches of the old Butterfield stage used to rumble past, carrying mail and passengers to and from San Diego. Prior to this, General Kearny and his weary half-starved troops marched by from the Mexican campaign. Lt. Col. Cooke, commanding the famous Mormon Battalion, was the first to cut a road for wheeled vehicles in 1847, and hundreds of 49'ers utilized it to reach the goldfields. The way led through Box Canyon, that narrow rocky defile opening into Mason Valley. It was here that the Mormon Battalion paused to pound, break, split and hew the rocks to enlarge the opening in order that their wagons could pass through. Even today the road is very rough in spots, as desert roads go, and we were fortunate in that it was dry. Once or twice we veered off the main road but otherwise encountered no difficulty.

After negotiating La Puerta Grade, a green oasis was revealed less than a mile from the descending road that opened into Vallecitos Valley. Nestling in the shade of great cottonwoods was the ranch home of Everett and Lena Campbell, who had come into this desert some 30 years ago to raise cattle. Ocotillos are a prominent feature of the vegetation surrounding the ranch. It is even said that a white-flowered *Fouquieria splendens* was growing here, and white forms of this shrub are extremely rare. Small clusters of *Echinocereus Engelmannii* thrived on the rocky slopes and here were clumps of low-growing, bushy chollas, apparently *Opuntia acanthocarpa,* scattered about the premises. Here, too, was seen *Dudleya lagunensis*, a glaucous perennial of which this region was the type locality. This species is closely related to the coastal *D. pulverulenta* but is more glaucous than pulverulent and has brick-red flowers. Conspicuous also was the dark green, resinous shrub, *Larrea tridentata* var. *glutinosa,* commonly known as Creosote Bush. Its most striking characteristic seems to be the pronounced odor of the leaves, which is even more noticeable after a rain.

Ocotillo (*Fouquieria splendens*)

Our visit to the Vallecitos desert would not have been complete had we missed Marshal and Tanya South, two rugged individuals who have returned to the primitive way of life with zest. Both are writers, who, when the last depression engulfed them, loaded all their belongings in their old car and drove out into the desert wilderness to establish their home. They built their cozy cabin atop a mountain on the western rim of the Colorado Desert and here they reared their children. This building of a home, where every bit of material had to be packed on backs and carried up the tortuous path to the top, was a slow process. They call their home "Yaquitepec" (Hill of the Yaquis), and only their most intimate friends know the location. When the Navy restricted that part of the mountain as a bombing range and moved them away from the target area, the Campbells offered them a refuge on their ranch. However, the Souths are back at Yaquitepec now. In the course of an investigation of desert plants, I had received much valuable assistance from the Souths and therefore was very anxious to meet these "back-to-nature" folks and discuss other problems in person.

Much more could be written about the trip to southern California, but this discussion covers only a small portion of my observations on the floral aspect of California deserts. Many more places were visited, many more interesting people met and, above all, a better knowledge of endemic plants obtained which will aid in growing California plants in our greenhouses.

Snow Trillium.—It is encouraging to report that the beutiful Snow Trillium (*Trillium nivale*) seems to be successfully naturalized at the Arboretum. When one says "successfully naturalized" with reference to such a touchy subject as the Snow Trillium, it means far more than being able to bring the species into flower for a year or so from bulb purchases elsewhere. It means that the number of plants is increasing year after year and that there is reason to hope that in a few more years we may have a spectacular display of theseunusual plants—a display, moreover, which can be counted upon to increase in loveliness from decade to decade, like snowdrops in an old English park. As was told in the BULLETIN for December 1945, bulbs of *Trillium nivale* were obtained in quantity and were planted in three different sites which seemed fairly similar to the places in which the species grows naturally. This spring found them eliminated in all but one spot, on the north side of the Circuit Road, just a little west of the East Bridge. There they not only flowered more profusely than last year, but, just as in their native home, are making attractive clusters of new little plants, a promise of many more flowers in the next few years. When thoroughly at home, there is nothing to compare with the Snow Trillium. It blooms as early as the snowdrops and the flowers are right down in the turf. One or two of them are interesting, but when they flower by the hundreds, as they can, they make a showy carpet of delicate bloom spread out amazingly in the raw cold weather of early spring.—EDGAR ANDERSON.

TOWARD MAKING "SPINACH" MORE ENJOYABLE

ROBERT W. SCHERY

Several years of Victory Gardening have been a severe drain on my enthusiasm in supplying the home larder with a diversified selection of delicacies. Now spinach is one of those items which sometimes pays dividends on St. Louis soils with St. Louis spring times, and then again no. After all, to get good spinach, a cool spring must combine with adequate moisture and a minimum of industry in getting the seeds planted early, to say nothing of supplying a ready source of nitrogenous fertilizer.

Last spring I discovered a promising lead which may in one way or another ameliorate the spinach problem. The answer is our old standby, BLACK-SEEDED SIMPSON leaf lettuce. We all know that it is possible to just scatter a little SIMPSON lettuce seed along the row, with scarcely a preliminary dig, to have more than sufficient lettuce. Having had in my garden the usual superabundance of young lettuce seedlings, which were fast crowding out the weeds, I took home a mess with careful instructions to the doubtful wife to prepare same exactly like spinach. The results were amazing—especially to Junior. A crisp, tender, luscious plate of greens resulted, without any of the objectionable (to some of us) taste of spinach. In fact, the most apparent taste was that of the butter lightly spread on top, a palatable one to much, if not all, of the human race. Just enough slightly "greenish" taste remained to remind one of springtime.

Now, fellow gardeners, with something so easily sprouted as SIMPSON lettuce, perhaps we can leave the spinach to the professional. Be certain to pull up the lettuce early (about the same time you would start to harvest spinach which had been seeded on the same date), when the plants are less than six inches tall and the leaves not yet tinged with that bitter flavor common to SIMPSON lettuce late in the season. As with spinach, sowings at intervals will supply a continuous crop throughout the spring.

Houstonias or "Quaker Ladies" are always in flower in Missouri pastures by the middle of March, if not before. If one knows where they grow a small piece of turf may be lifted carefully, placed on a saucer and the plants brought into flower in the house.

We have two kinds of Quaker Ladies in Missouri which are very much alike, *Houstonia minima* and *Houstonia patens*. Both of them have brilliant little flowers of dark blue (or occasionally white) which blossom right down in the turf in early spring pastures. The differences between them are rather technical. *Houstonia patens* is a little more slender in leaf and in habit and has a preference for sandy locations.

NOTES

Beginning with the current volume, the second number of the quarterly ANNALS OF THE MISSOURI BOTANICAL GARDEN will appear in May instead of April.

Dr. G. W. Martin, Professor of Botany, University of Iowa, Iowa City, and a group of graduate students in botany from that institution, visited the Garden and the Arboretum during the Easter vacation.

Ladislaus Cutak, in charge of Succulents at the Garden, has returned from a seven-weeks exploration trip in Mexico. Field work was done chiefly in the Isthmus of Tehuantepec and on the Central Plateau, cacti, bromels, aroids, and various ornamentals being collected.

Dr. Gustav A. L. Mehlquist, Research Horticulturist, spent ten days in southern California recently. At Santa Barbara he visited the Cymbidium Show, March 27-30, and at Los Angeles he attended the biennial meeting of the Orchid Society of Southern California. He also visited various orchid establishments in order to discuss problems of nutrition relating to orchids.

Recent visitors to the Garden include Dr. Ernst Gäumann, Professor of Botany, Eidgen. Technische Hochschule, Zurich, Switzerland; Dr. H. S. Conard, Visiting Investigator, University of Iowa, Iowa City; Dr. J. P. Carabia, of the Universidad de la Habana, Habana, Cuba; Mr. David J. Rogers, botany major at the University of Florida, Gainesville; Mr. Henry J. Freyman, orchid enthusiast, of Kansas City, Mo.; Mrs. George Elder of Arcadia, Mo.; Mr. John C. Hahn, of the University of Illinois, Urbana.

The Missouri Botanical Garden staged two exhibits at the St. Louis Flower and Garden Show held at the Kiel Auditorium, March 18-23: a little garden and an orchid display. The former, designed by Paul A. Kohl, Floriculturist to the Garden, occupied 850 square feet and consisted of a formal bulb garden, a small greenhouse, and a kitchen garden. A brick walk bisected the bulb garden, and a picket fence separated it from the kitchen garden. Flowering plants filled the greenhouse and were also interplanted with the vegetables. The Garden was awarded a cup for this exhibit. The orchid display, staged by W. H. Kruse, consisted of about 500 of the hybrids raised at the Garden. A feature of the exhibit was the rare "Chinela" orchid, which bore two flowers with petals one foot across.

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

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Missouri Botanical Garden Bulletin

Vol. XXXV MAY, 1947 No. 5

LETTUCE—THE SALAD PLANT

THOMAS W. WHITAKER[1]

Although the ancient Greeks and Romans were not aware of its potential importance, an humble roadside weed occasionally grown in their gardens for its edible rosette leaves was destined to play an important role in the food economy of our nation. Since the early years of the present century, under the skillful guidance of the modern mechanized farmer (see figs. 1 and 2), the plant physiologist, the plant breeder, and the refrigeration engineer, it has been possible to place at least one lettuce leaf on almost every salad consumed by Mr. and Mrs. Everyday American.

Lettuce is one of our most important home-garden plants, and one of the principal vegetable crops. By reason of its relatively high vitamin and mineral content, combined with a low caloric value, it finds a welcome spot in almost any diet. Some idea of its importance in our economy can be gained by a quick glance at the car-lot movement to market in 1945, the last year for which figures are available. Shipments averaged slightly over 1300 carloads per week if we include the movement by truck. This means that the American public consumed on the average about 200 freight carloads of lettuce per day—the basis for several million salads.

Because of its importance as a vegetable and as a garden plant, it was thought that the readers of the BULLETIN might be interested in one phase of the series of events that has made it possible to bring to the American family table at least a salad per day throughout the entire year

History and varieties.—There seems to be no doubt that cultivated lettuce (*Lactuca sativa* L.) is a derivative of wild lettuce (*L. serriola* L.). Both have nine pairs of chromosomes, and they hybridize readily, either

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[1] Geneticist, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Dept. Agr., La Jolla, Calif., Fellow of the John Simon Guggenheim Memorial Foundation, and Visiting Investigator, Missouri Botanical Garden, 1946-47.

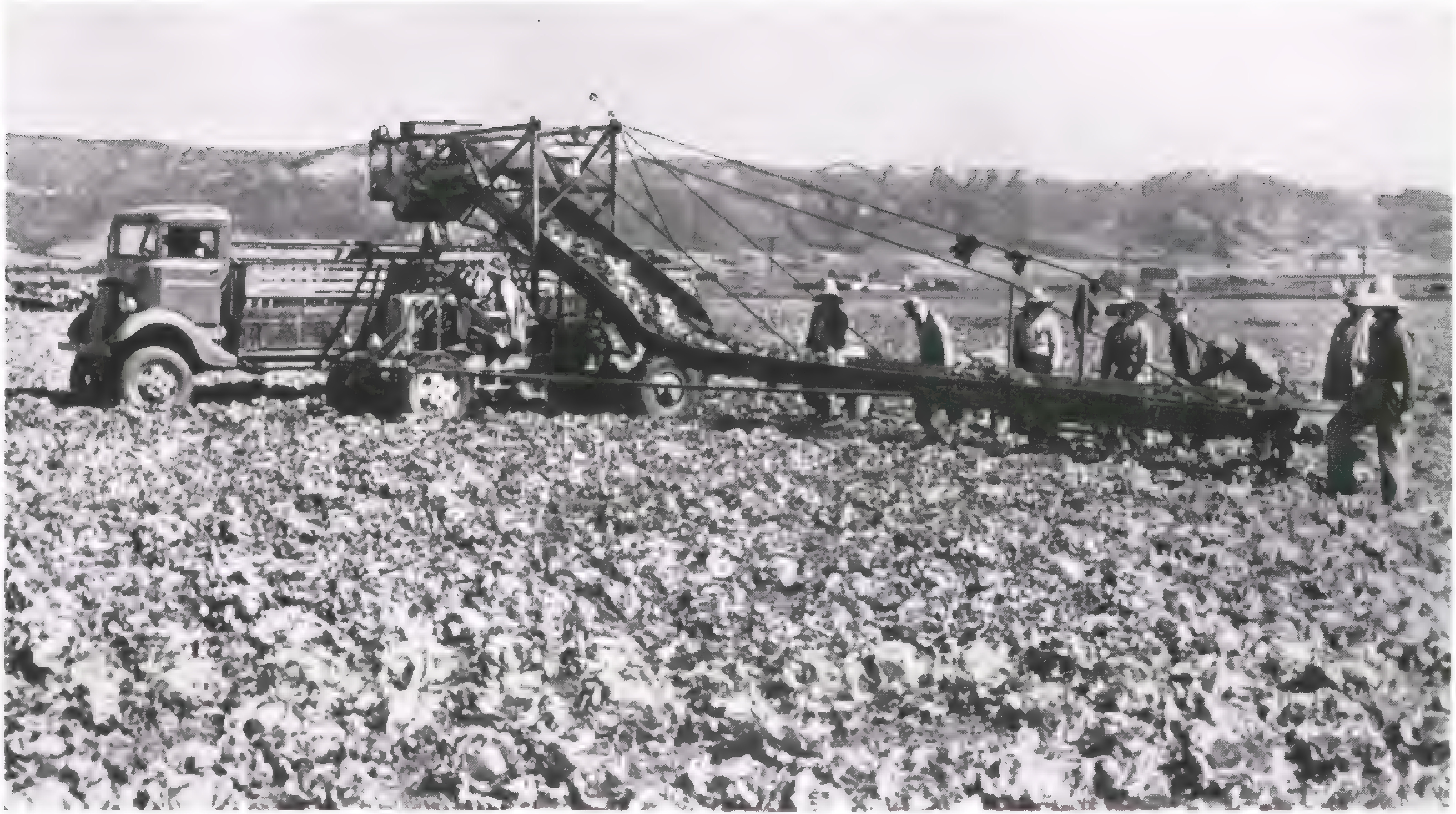

Fig. 1. Lettuce harvesting scene, showing a mechanical loader in operation. The men cut the heads just below the surface of the soil and place them on the conveyor. The conveyor carries the lettuce to the truck, which transports it to the "shed" where it is prepared for marketing. (Photo courtesy of the California Agricultural Experiment Station.)

naturally or artificially, producing fertile progeny. Our best information up to the present seems to indicate that wild lettuce is a native of the Mediterranean basin and adjacent areas of southwestern Asia. Lettuce was evidently domesticated at a very early date—possibly as early as 550 B. C., when it is said to have appeared on the tables of certain Persian kings.

Innumerable varieties have been offered to the public by the seed trade at various times. In 1885 the New York Agricultural Experiment Station described 87 varieties, with almost 600 synonyms. In his catalogue, published in 1904, Tracy[2] lists more than 100 distinct varieties. Since that time many new varieties have been introduced, but at present not more than twenty-five are of any commercial significance.

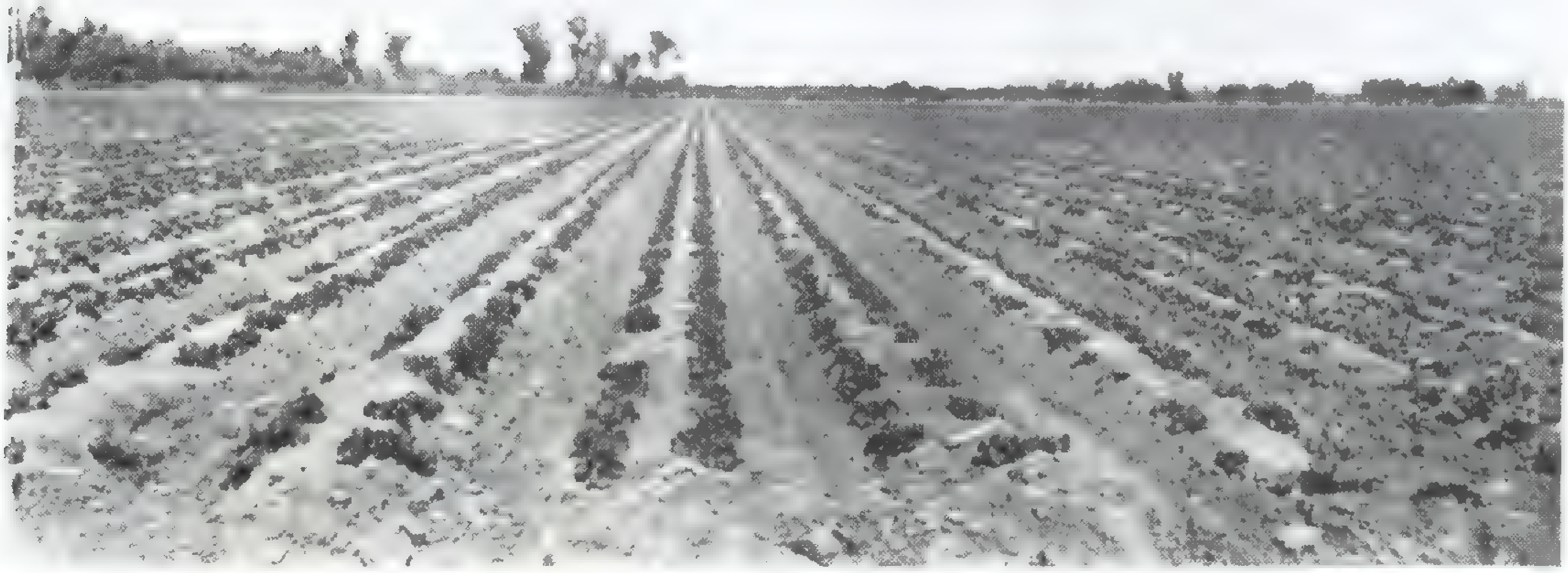

Fig. 2. A field of young lettuce plants about three weeks after thinning. Note the two rows planted in elevated beds to facilitate irrigation and drainage. The beds are about 40 inches from center to center and 6–8 inches high. The machinery for planting, irrigation, cultivation, and harvesting is adapted to the "bed" system.

Lettuce varieties can be conveniently pigeon-holed into five classes, depending upon the texture of the leaves, whether or not they ordinarily form heads, and the part of the plant used for edible purposes. These five classes, with a brief characterization and the chief varieties under each class, are shown in the table which follows.

Development of new varieties.—The crisp-head class is by far the most important from a commercial standpoint. It is probable that 90-95 per cent of all the lettuce marketed in this country consists of varieties of this

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[2] Tracy, W. W. American varieties of lettuce. U. S. Dept. Agr. Bur. Pl. Ind. Bull. No. 69. 1904.

CLASSIFICATION OF LETTUCE VARIETIES

Class	Characterization	Varieties	Edible portion of plant
Crisp-head	Leaf crisp-textured; head firm. Well-adapted for shipping	Imperial 44 Imperial 152 Imperial 615 Imperial 847 Great Lakes	Leaves
Butter-head	Leaf buttery or of smooth, velvety texture; head soft. Poor shipper	BIG BOSTON UNRIVALED	
Loose-leaf	Non-heading	GRAND RAPIDS BLACK SEEDED SIMPSON OAK LEAF BIBB	
Cos or Romaine	Leaf stiff; heads elongated, soft; growth upright	PARIS WHITE COS	
Celtuce	Enlarged edible stem	CELTUCE	Stems

type. The problems connected with the development of well-adapted and disease-resistant varieties of head-lettuce for the different producing regions of the country are many and varied. Possibly the procedures used to attack two of these problems which have been more or less successfully solved will serve to illustrate the application of our methods.

An initial step of prime importance consists in assembling an extensive collection of strains, varieties, and close relatives of the species concerned. With the assistance of the Division of Plant Exploration and Introduction, by exchange with other plant breeders, and through our own efforts at collecting, a fair sample of the variability within the two species *Lactuca sativa* and *L. serriola* is maintained. This collection has proved to be invaluable as a source of useful breeding material (see fig. 3).

Downy mildew (*Bremia lactucae* Reg.) is a very troublesome disease of lettuce. Plants attacked by this fungus generally become dwarfed, yellow, and unfit for market. Cool, damp climatic conditions are very favorable for the development of the disease, and under such an environment it tends to do maximum damage. Up until 1932 most of the important strains of commercial lettuce were immune to the disease. In that year a new physiological race of the fungus appeared to which all of the better varieties of lettuce were susceptible. This event immediately created the problem of producing acceptable strains of lettuce resistant to the new race of mildew. Testing a number of varieties and types, two were found that were immune to all the known races of mildew. In addition, a collection of seed of *Lactuca serriola* from Russia was obtained which produced some immune plants.

A series of suitable crosses demonstrated that immunity to the disease is dependent upon a single dominant gene. In other words, if we cross a plant that is homozygous (breeds true to type) for immunity with a plant susceptible to the disease, all of the first-generation plants are immune, and in the second generation we recover approximately three immune plants to one plant succeptible to the disease. Provided with this information it is a relatively simple, but laborious, task to transfer the gene for immunity to a lettuce background having the consumer qualities in which we are interested. By rigid selection among the immune plants for desirable economic characters, further crosses with susceptible varieties, plus continuous testing for resistance to mildew, we have produced a number of strains fully equivalent in all respects to some of the commercial varieties but having the additional feature of being immune to all races of downy mildew. These resistant strains are now in the process of being tried out on a commercial scale, and one of them has been released to the seed trade.

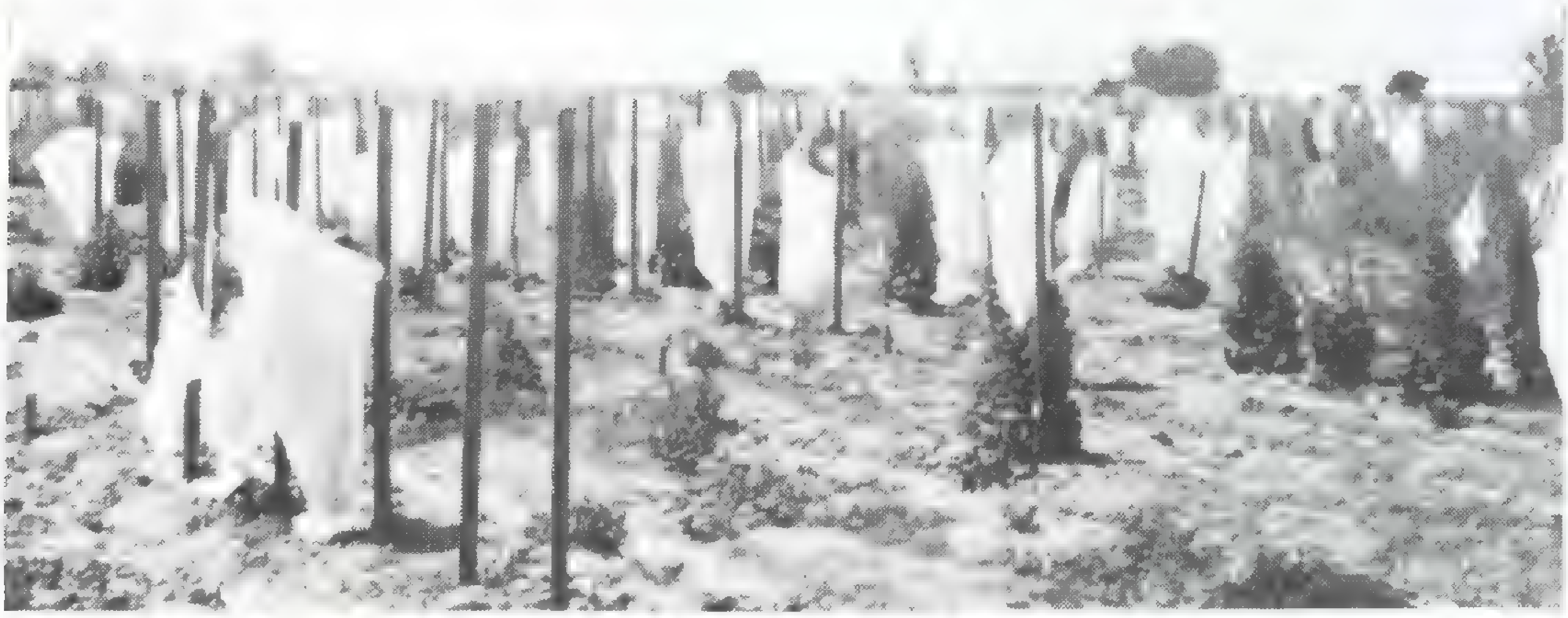


Fig. 3. Lettuce breeding plot. Plants selected for self-pollination are enclosed in cheesecloth bags to prevent chance pollination by insects.

The agricultural agencies representing eastern vegetable growers have long been interested in the development of strains of crisp-head lettuce adapted to their soil and climatic conditions. The crisp-head, so-called "Iceberg", types of lettuce have practically ruined the market for the butterhead types which these growers formerly produced. The problem is one of locating commercially desirable strains that will form good, solid heads under comparatively high temperatures, be reasonably free from tip-burn (a darkening of the leaf margin), and have suitable consumer qualities. In cooperation with the New York Agricultural Experiment Station, using simple trial and error methods, a strain of lettuce was located fitted for producing good heads on the muck soils of New York in spite of several severe shortcomings. This strain was released to the seed trade under the name IMPERIAL 44. Surprisingly enough, although developed specifically for the eastern portion of the country, it has proved to be well adapted to certain of our western producing areas.

Recently we have been more successful in solving the problem of lettuce production under eastern conditions by hybridization of some of our Imperial strains with the variety BRITTLE ICE. The latter is an old variety of no commercial importance at present, but it does have certain desirable traits. Among the progeny from the above crosses were certain individuals which combined the slow bolting habit of the IMPERIAL strains with the capacity to form a head under relatively high temperatures, typical of BRITTLE ICE. From among these individuals we were able to isolate, by selection, strains with the above features which are very resistant to tip-burn. Two of these strains have been released to the seed trade (GREAT LAKES, IMPERIAL 456—see fig. 4). In appearance they are quite distinct from other crisp-head varieties, the leaves being glossy, light green, very crisp-textured, finely toothed along the margins, and with rather prominent midribs. The plants, particularly GREAT LAKES, are extremely robust and vigorous.

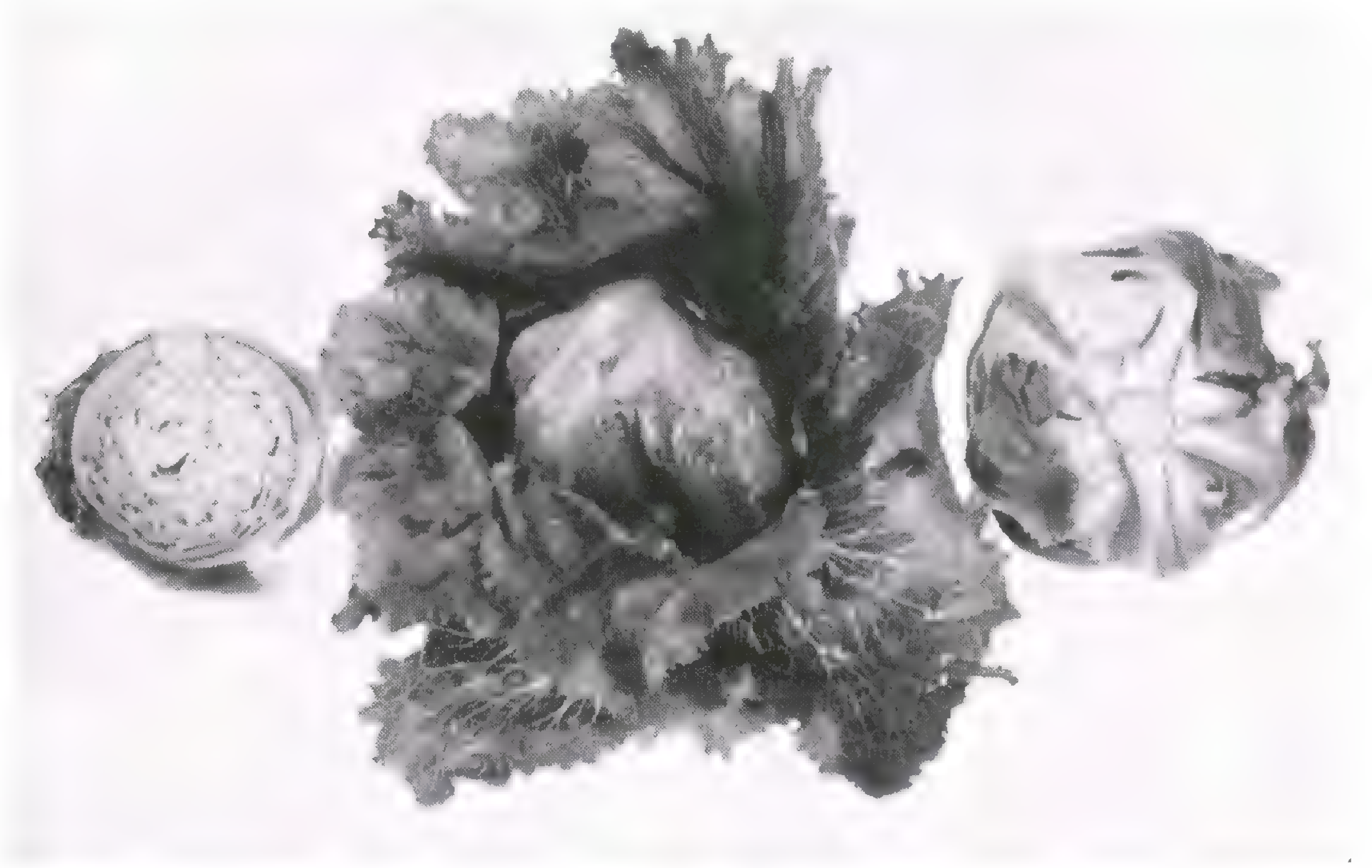


Fig. 4. GREAT LAKES variety of lettuce. Note the large wrapper leaves, exposed head, short seed stalk, and protruding midribs of this variety.

PLANTS FOR A ST. LOUIS GARDEN

EDGAR ANDERSON

Only those who have struggled with the problem can understand the difficulties of gardening in St. Louis, and by St. Louis we mean just that, and not the area around about. The small yards, the general lack of sunshine, the high proportion of the area which is right next to a wall of some sort or other (house wall, garage wall, or a high board fence) combine to make gardening much more difficult than it is in Kirkwood or Webster, or even Richmond Heights. Added to all these general difficulties are the special ones to be found in many parts of the city, the pavement ants which will girdle Calendulas and Zinnias, the heavy red clay subsoil exposed by grading in many parts of the town and whose only proper use is for tennis courts, or the equally difficult places which were filled in with ashes and rubble with only a thin veneering of soil on top.

If you have the kind of garden in which Johnny-jump-ups will seed themselves and Korean Chrysanthemums will flower year after year with no resetting, this article is not designed for you. Some of the strong-growing plants recommended here would run wild and become a pest in such a garden. It is written rather for the real city gardener, who never digs deeply without finding a bit of brick or an old piece of crockery, and who has to learn by sad experience just which plants can be made to grow on those parts of the garden which are shaded by buildings and have no sunshine at all in the late fall and winter.

The following twenty-five plants will all thrive in the really urban parts of St. Louis. Several of them, as noted in the discussion, require sunshine, but some of them will stand a great deal of shade. As a group they will provide continuous bloom from late March to the end of October. Few of them need to be sprayed or dusted for particular pests. Most of the perennials can go ten or fifteen years without resetting, and the annuals can be counted upon to reseed themselves in at least a portion of the garden. All will benefit by fertilizer, but most of them are hardy enough to bloom without it. None of them, however, are fond of grass in the flower bed and will require weedings, particularly in the spring before they are large enough to resist competition. They are listed roughly in the order of bloom, with shrubs and ground-covers in a special section at the end.

Narcissus FEBRUARY GOLD.—This rich yellow trumpet daffodil is a comparatively new variety and is not known to many St. Louis gardeners, but it is most vigorous and can be depended upon to give a good show of bloom before the Forsythias come into flower. The bulbs increase fairly rapidly and will need to be separated and reset in about four or five years, or replaced by newly purchased ones.

Dwarf Iris *(Iris pumila* var. *atrocaerulea)*.—This little early Iris, which comes into flower a few days after the Forsythias, should be much more widely planted here, since it is very much at home in Missouri. It wants sunlight and good drainage and it is very intolerant of grass, but is otherwise a most obliging plant. It is apparently very fond of cement and will grow well right up next to a sidewalk, or along the south side of a stone wall. It has run wild in southern Missouri and one can buy it by the bushel from old German gardens just outside the suburban area. In addition to the genuine early *Iris pumila*, whose flowers are stemless, there is another variety just a little later, with somewhat larger flowers and a very short stem, which is probably a hybrid between *Iris pumila* and *Iris Chaemaeiris*. By interplanting the two varieties one can have a longer season of Iris bloom.

Narcissus SIR WATKIN.—By far the sturdiest and most floriferous of all the daffodils under our conditions. It will bloom in spite of rain or sleet or snow, and the bulbs will not have to be reset for ten or fifteen years.

Iris Kochii MIDNIGHT or BLACK PRINCE.—This intermediate Iris is extremely floriferous even for an Iris, and has flowers of an intense dark purple. They are of excellent quality, and although this is one of the oldest varieties of Iris in St. Louis gardens it is still one of the best.

Iris germanica.—The modern tall bearded irises are one of the glories of middle-western gardens, but most of the varieties in current catalogues are too overbred for city conditions. One can do better by looking about in other city gardens and picking up old-fashioned varieties which will be much more dependable, if not so breath-taking. The "German Flag" irises, with their two tones of blue, will grow and blossom, almost without attention, in spots where fancier varieties will gradually die out. They don't really like shade, but they will continue to blossom in places which have a good deal of it and they are really a splendid flower, even if they are old and cheap.

Iris pallida ALBERT VICTOR.—Few of the newer hybrids will do so much for so little as this old-fashioned variety. It is no longer listed by Iris specialists but there are plenty of gardens in south St. Louis where it makes masses of soft gray-blue every spring. If your Iris-collector friends tend to sneer at this old-timer, you may compare it with some of their more expensive new hybrids. It may not have blossoms which are as large, or spectacularly colored, but it has a perfection of form equalled by only a few of the modern varieties.

Hemerocallis (HYPERION, CALYPSO, and *fulva*).—The last of these is the old-fashioned orange day-lily, which can stand more neglect and grow in more kinds of places than any other flower which has ever been tried in eastern North America. You may not particularly care for it; after all the plant is a bit weedy, but you can put it at the back of the garden and get a mass of foliage, and a bright streak of color which will improve the garden picture as a whole. There are many beautiful new varieties of Hemerocallis, some of which do very well in the city, HYPERION and CALYPSO being outstanding under such conditions.

Annual Larkspur, Calliopsis, Bachelor's Buttons.—All three of these common annuals can be planted more or less together and all can be counted upon to seed themselves in your garden, provided it is sunny enough. Larkspurs will take the most shade and Calliopsis the least. If they don't do well in one part of your garden try them in another. They are apparently rather sensitive to soil reactions and to the presence of certain other plants. All three have a distressing habit of seeding themselves heavily in the parts of the garden where you may not particularly want them, and then failing altogether to come up in the places you had planned for. Once well established, however, they should seed themselves year after year.

Elder Daisy.—This is just a selected form of the common white daisy of meadows and pastures, but it is very free-flowering and has shortish stems which are not so apt to break and bend as those of the commoner sort. It is very responsive to sun and will crowd into the sunniest places in the garden, and yet not flourish at all in shadier spots just a few feet away.

Hollyhock.—If you grow these from seed it will take two years from seed to flower. Once the plants are well established in the garden, however, they will seed themselves, and these self-sown seedlings nearly always seem to be hardier than the original plants.

Blackberry Lily *(Belamcanda chinensis)*.—This old-fashioned flower looks much like an Iris until it blooms. The little cinnamon and orange-red flowers are borne freely all over the top of the plant and they blossom through the very middle of the summer. There is a good deal of difference in color and color pattern from plant to plant so that a selection of different plants grown near each other adds variety and interest. If one allows the flowers to go to seed, the dark shiny seeds, which give the plant its common name, will be attractive in the fall garden.

Showy Live-forever *(Sedum spectabile)*.—No matter how hot and dry early September may be, *Sedum spectabile* can be counted upon to give a good display of its misty pink flowers. The gray-green leaves make an attractive note in the flower border during the spring and summer. While it does its best in full sun and can grow in places too hot and dry for many garden perennials, *Sedum spectabile* will grow and flower in partial shade.

Blue Mist Flower *(Eupatorium coelestinum)*.—This native wild flower is something like a perennial Ageratum. It is altogether too weedy and rampant for most suburban gardens but in the city this added strength becomes a virtue. It can easily be controlled by pulling it up from those parts of the garden where it is not wanted. It does well in the sun but can stand quite a lot of shade, and if the first flowers are cut when they begin to fade it can be kept attractive for a long period in the late summer and early fall.

Aster turbinellus.—This beautiful Ozark Aster is not yet in the trade but it transplants easily and increases rapidly enough so that once a plant has been acquired it can be increased by division. Many of our wild asters become weedier in the rich soil of a garden but not *Aster turbinellus.* It merely produces larger and larger sprays of its attractive clear blue flowers and seems even more at home in a city backyard than it did on a rocky hillside in the Ozarks.

New England Aster *(Aster novae-angliae).*—This species is available in the trade in various shades of rose or purple. If one allows it to go to seed, volunteer seedlings will appear here and there in the garden, many of which will be worth keeping.

Ozark Allium *(Allium stellatum).*—This beautiful bulbous plant with rosy-pink umbels of flowers from August to October is one of the choicest things for a city garden and a most dependable bloomer. It suffers from the fact that technically it is a wild onion, albeit a most beautiful one. It is not yet in the trade and if one wants it for his garden he must keep his eye open for one of those dry Missouri hillsides where it grows in great profusion. However, it transplants readily at all seasons of the year, even when it is in full bloom.

Chrysanthemums.—The last two decades have seen a great development of hardy chrysanthemums in this country. Most of these fancy new varieties can be grown successfully in the city, but nearly all of them require resetting every two or three years if they are to give a satisfactory display. If you haven't the time and energy for this keep your eyes open for old-fashioned varieties in dooryard gardens in the market-garden district. There is a very handsome variety, deep-pink fading to white, which abounds in such places around St. Louis. It will flower dependably for five to ten years without resetting, and while it doesn't like shade it can stand a good deal of it and still flower acceptably.

SHRUBS

One shrub leads all others in its adaptability to the city area, the old-fashioned snowball. It will take full sun or a good deal of shade. It grows well in poor soil and requires no special pruning. The flowers are attractive in May and its leaves hang on late and then color a beautiful red bronze before they fall.

Mock-oranges or Syringas are nearly as adaptable, though most people prune them too severely. Since they come in a variety of sizes it is better to select a low-growing kind and let it have full development than to attempt to dehorn one of the large ones every year.

Forsythias also do well in the city area but are too large for most city gardens. They do not flower well when cut back severely year after year.

GROUND COVERS

The shadier portions of a city garden will look better with a good ground cover than in grass, and they will take much less time and effort. Even the most difficult of city backyards can be made reasonably attractive by paving the central portion with brick and then growing a good ground cover all along the sides and at either end.

For the shadiest places wild ginger is excellent. Though this can be obtained in the trade, the local Missouri species and varieties are stronger-growing and will make a more effective ground cover. All the wild gingers like rich soil and the earth should be heavily mulched before one attempts to grow them.

Hardy Ivy is dependable both in sun and shade, particularly if one uses the new Balkan varieties introduced recently by the Garden, MBG "Bulgaria" and MBG "Rumania." These will take a year or so to establish but once this is accomplished they require almost no attention from year to year.

Periwinkle *(Vinca minor)*, commonly called myrtle in the United States, is also dependable, though it will not do so well in the city as it does in the suburbs. Bowles' variety, with its large blue flowers, is no harder to grow than the ordinary variety and is much more effective when it blossoms in the early spring.

The Button-bush, *Cephalanthus occidentalis*, perfumes the air of swampy places during most of the summer. Its small white flowers are borne in globular heads as large as a marble and they are deliciously fragrant.

A special use for scented Pelargoniums.—Several of the scented-leaf geraniums, or Pelargoniums as they are more properly called, are unusually resistant to summer drought. If you are going away from home in July and August and are looking for something which will pull through that period try using some of the scented-leaved geraniums. The skeleton-leaf variety is particularly dependable. It will come through the summer in a garden urn or a flower box with almost no attention. When one returns after his vacation it will look more or less burned up, but with a good watering and the removal of dead leaves from around the base it will freshen up very quickly and look attractive within a few days.

SPRING 1947 VS. SPRING 1946

ROBERT W. SCHERY

Amongst any group of weather prophets on any local street corner one hears it said that last year's spring was unusually early, and that this year's spring is unusually late. Comparison of flowering dates for 1946 and 1947 in the St. Louis area, especially about the grounds of the Missouri Botanical Garden, supports this assertion. In 1946, in order to help the Allergy Laboratory of the Washington University School of Medicine with hay-fever work and for purposes of general interest, the first day on which certain common plants were observed in flower was recorded. Similarly, first-flowering dates were noted for this year (1947). Selected data from these records are presented in the accompanying table. They show that most plants of the St. Louis area flowered from two and one-half to six weeks later in 1947 than in 1946. Averaging all species, the delay in "arrival of spring" 1947, compared to that of 1946, was about four weeks. Since these flowering records are not available for many years back, we can't at this time suggest what would be a "typical" or "average" season. However, it seems reasonable to assume that 1946 was approximately as much early as was 1947 late. In other words, last year's spring may have been two weeks early, and this year's spring two weeks late.

No strictly accurate first-flowering dates can be ascertained. Often plants in a protected or more favored location will flower days before the same species does in a less favored spot. Or often some tree or shrub in the county may be in flower before the same kind in the city (or *vice versa*). The records in the table have when possible been of the same plants in the same location for both years. However, the tornado of September, 1946, destroyed many of the trees and shrubs of the Garden grounds that were the basis of 1946 records, necessitating substitutes to be found wherever observable. Furthermore, it is difficult to determine exactly when a plant is in flower. Sometimes, as in the case of the redbud, the flower remains in the bud stage for a considerable length of time, especially if the weather be cool. In the accompanying table, plants were generally considered "in flower" if pollen was mature or being shed. Some plants, such as the American Elm, were considerably "confused" by the earliness of the 1946 season and never did flower simultaneously (for the species) nor in quantity. Quite a number of species that produced flowers before leaves in 1946 produced leaves before flowers in 1947.

It will be interesting to note whether plants not yet in flower as of this writing (May 1) maintain the four-week average delay shown by the earlier-flowering species. Possibly, with continued warm weather in early May, they will flower more or less at their "normal" date, and thus lessen the difference between 1946 and 1947 flowering dates for late spring plants. If so, we will have had a short or telescoped spring this year, as compared to a protracted one in 1946. In any event, spring hayfever sufferers have had almost one month's more grace this year before onset of their discomfort than they did in 1946.

SPRING FLOWERING DATES OF 1947 COMPARED TO 1946

Common name	Latin name	Approximate date of first flower		Weeks later in 1947 than in 1946 (to nearest ½ wk.)
		1947	1946	
Cornelian Cherry	*Cornus mas*	March 18	Feb. 28	2½
Silver Maple	*Acer saccharinum*	March 24	Feb. 11	6
American Elm	*Ulmus americana*	March 24	March 11	2
Chinese Elm	*Ulmus parvifolia*	March 24	Feb. 18	5
Hazelnut	*Corylus americana*	March 24	Feb. 27	3½
Honeysuckle, various kinds	*Lonicera fragrantissima*, etc.	March 26	Feb. 28	4
Chickweed	*Stellaria media*	April 1	March 5	4
Golden-bell	*Forsythia* sp.	April 2	March 4	4
Magnolias	*Magnolia stellata,*	Week of April 7	March 5	5
	M. Soulangeana	” ” ”	March 5	5
Ash	*Fraxinus americana*	” ” ”	March 12	4
Boxelder	*Acer Negundo*	” ” ”	March 21	3
Cultivated Plums	*Prunus* sp.	” ” ”	Feb. 28	5½
Fragrant Sumac	*Rhus aromatica*	” ” ”	March 21	3
Cottonwood	*Populus deltoides*	” ” ”	March 8	4½
Various wild flowers	Claytonia, Anemonella, etc.	Before April 18	Before March 20	4
Various shrubs	Spiraea, Berberis, Mahonia, etc.	April 20	Late March	3
Sassafras	*Sassafras variifolium*	April 22	March 18	5
Annual Blue Grass	*Poa annua*	April 22	April 2	3
Redbud	*Cercis canadensis*	April 25	March 14	6
Lilac	*Syringa vulgaris*	April 26	March 26	4½
Oaks	*Quercus* sp.	April 27	April 1	4
Buckeye	*Aesculus glabra*	April 27	March 27	4½
Kentucky Blue Grass	*Poa pratensis*	April 29	April 5	3½
Mulberry	*Morus alba*	May 1	April 2	4
River Birch	*Betula nigra*	Not flow. by May 1	March 31	4+
Sycamore	*Platanus occidentalis*	” ” ” ”	April 1	4+
Hickory	*Carya Buckleyi*	” ” ” ”	April 5	4+
Wild Cherry	*Prunus serotina*	” ” ” ”	April 5	4+
Black Walnut	*Juglans nigra*	” ” ” ”	April 7	4+
Black Locust	*Robinia Pseudo-Acacia*	” ” ” ”	April 15	4+
Sour Dock	*Rumex Acetosella*	” ” ” ”	April 19	4+
Persimmon	*Diospyros virginiana*	” ” ” ”	April 28	4+
Smartweed	*Polygonum Persicaria*	” ” ” ”	May 3	4+
Sheep sorrel	*Chenopodium album*	” ” ” ”	May 3	
Narrow-leaf Plantain	*Plantago lanceolata*	” ” ” ”	May 3	
Catalpa	*Catalpa bignonioides*	” ” ” ”	May 6	
Later wild flowers	Smilacina, Krigia, Melilotus, etc.	” ” ” ”	May 9	

DARIEN

PAUL A. ALLEN

Every schoolchild knows that Balboa first sighted the Pacific from a mountaintop on the Isthmus of Panama, and many could, with reasonable accuracy, place the locale as having been somewhere in "Darien." Although the highroad of discovery and conquest crossed this vast forested tract of eastern Panama, shorter routes were found to the cities established on the drier shores of the great south sea, leaving Darien to its primitive Indian tribes. The building of the Panama Canal has focused the spotlight of the modern world on this strategic area, yet near-by Darien is little changed. No roads have penetrated its forests, so that a shield of isolation has been between the remnants of the aboriginal population and civilization. Approach can be made only by sea, on one of the small coastwise banana boats whose cramped quarters do not encourage casual visitors.

A recent collecting trip may be taken as typical. Departure from the Panama City waterfront was with the tide, the rusty anchor being weighed at about 10 P. M. The night was dark, but delightfully calm. There was much phosphorescence in the water, the bow waves breaking in luminous fire. Previous experience had taught me to shun the tiny, air-tight, cockroach-infested cabins, so a comfortable night was spent on deck in my hammock. Dawn found us at the entrance of San Miguel Bay, with the familiar haze over the land, the long rolling surf breaking over the entrance bar, and the tiny thatched fishing village of Gonzalo Vasquez barely visible in the distance.

Ropes rattled in the rigging, while the masts and cargo booms described lazy arcs against the sky. Long dark serpentine lines of sea birds skimmed the water above fleeting schools of fish, and bands of porpoise sported about our bow, breaking the surface in their incomparably graceful fashion. Many uninhabited islands dot the inner channel, where dense stands of Cuipos, leafless at this season, tower over the lower, darker vegetation. Sand beaches alternate with bold rocky headlands, on one of which near La Palma stand walls of a ruined stone fort, half swallowed by encroaching forest, relic of Spain's colonial empire. La Palma, capital of the province, is an unattractive line of frame houses set on tall stilts above the fluctuating tides, backed by poorer thatched houses plastered, tier above tier, against a steep, barren hillside.

Extensive mangrove swamps border the estuary above this point, having a typical climax association of *Rhizophora Mangle, Avicennia nitida,* and *Laguncularia racemosa.* Open spots are filled with the common swamp fern, *Acrostichum aureum* or spiny thickets of *Bromelia Pinguin.* Decreasing salinity in the water above Chepigana encourages numerous other species typical of such situations. The short-trunked swamp palm, *Corozo oleifera*, with its sessile, cone-like clusters of orange fruits, is very common, associated with the spiny *Astrocaryum Standleyanum* and the graceful *Euterpe panamensis*, the latter two palms indicative of the Atlantic coast character of the flora. Frequent are huge buttressed trees of *Prioria copaifera*, as are *Bombax barrigon*, *Pachira villosula*, and the grotesque *Cecropia mexicana*. Spots of vivid color were provided by the red-winged fruits of *Triplaris americana*, and the pink flowers of *Tabebuia pentaphylla*.

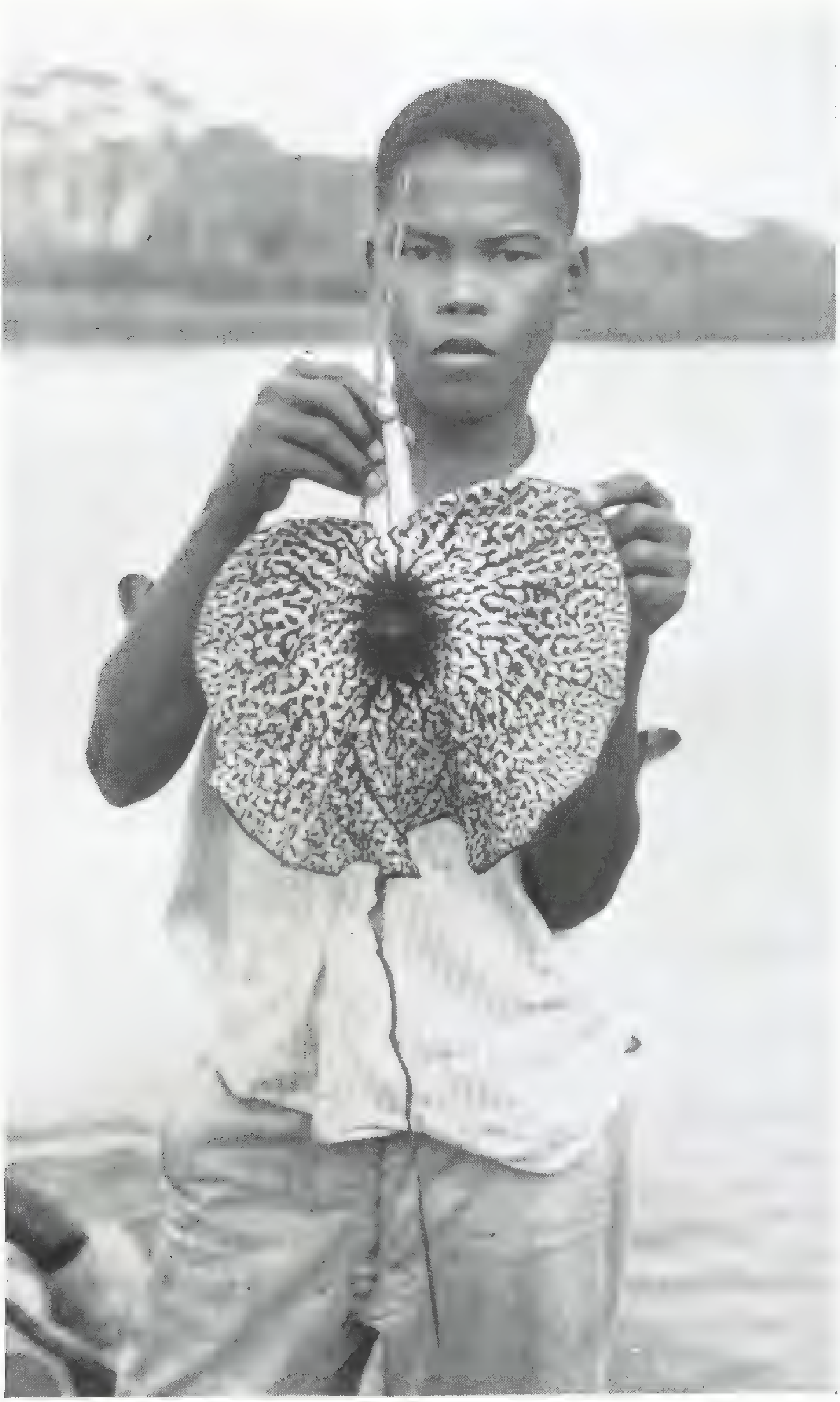
Loading Bananas, El Real, Darien

At the junction of the Rio Tuira and the Rio Chucunaque our craft grounded on a mud flat, so we had to wait an hour backed against a thicket of sagittate-leaved *Montrichardia arborescens* until the rising tide carried us off. After the giant rivers of South America, the Tuira looked a tiny stream indeed, with barely room at the Real waterfront to accommodate three of the rival banana boats. With a roar of rusty chain our anchor was down, and bare brown Indians and ragged blacks began poling their banana-filled *piraguas* alongside for unloading. Here the banana is king, and, as in most areas of the sort, is cultivated to the virtual exclusion of everything else; as a consequence away from Indian settlements fresh food is difficult to obtain.

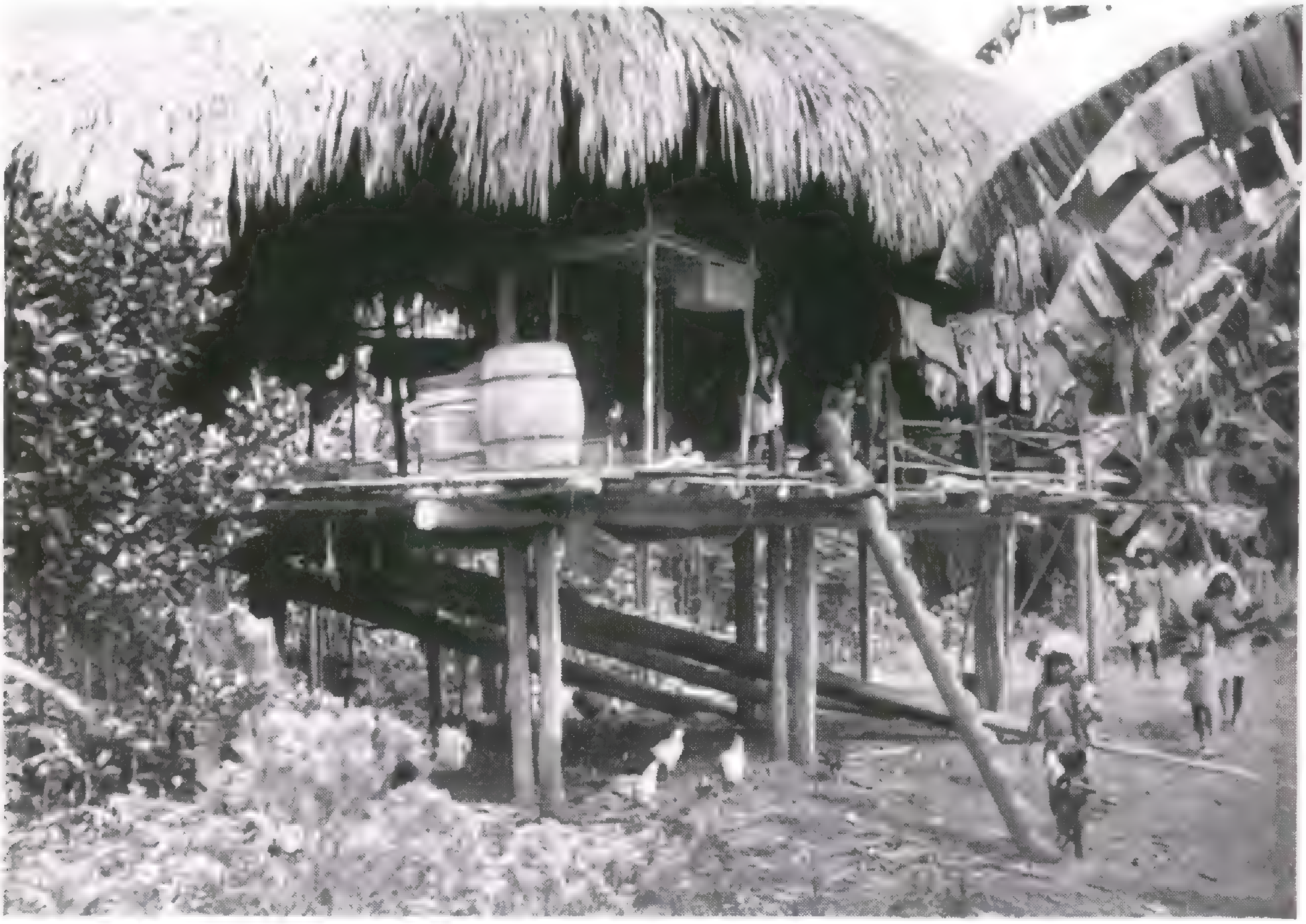
Bananas pay for *machetes,* tins of sardines, crackers, rice, coffee, sugar, and the little clothing needed, not to mention *aguardiente.* Even after a round of drinks with friends in a local *cantina,* there is often a surplus to be ventured, with the professional gambler seated nightly at the waterfront calling, "Try your luck. Who will have supper at my expense?" Far into the night there are vibrating drums, clapping hands, and high-pitched singing accompanying the dances, the perspiring blacks rhythmically posturing and gesticulating, watched by rows of impassive Indians.

Gray morning light revealed the shadowy bulk of Cerro Piri in the far distance, across the vast pastures of high grass which surround El Real, with clumps here and there of giant trees representing remnants of the original forest. Orchids are conspicuously absent, as are epiphytes in general, unlike any other part of Panama known to me. Blacks and Indians, having spent their earnings, were starting the long voyage home to Yape or Boca de Cupe, poling their *piraguas* against the current, three or four being in view at every turn of the meandering river course. Areas of rich flood plain on alternate banks are entirely in bananas, with remarkably little evidence of the dread Panama disease which has ravaged so many plantations. Bunches of twelve and thirteen "hands" are common, and it seems that this region may expect to profit by this easy-money crop for many years to come. Much of the original forest has been felled along the river, but occasional low rocky ridges retain patches of timber. Conspicuous are gigantic trees of *Cavanillesia platanifolia,* whose interlocking crowns often form a solid canopy, interspersed with *Ceiba pentandra, Lecythis tuyranae, Anacardium excelsum, Chrysophyllum Cainito, Schizolobium parahybum,* and *Ficus crassiuscula.* Occasional specimens were seen of the magnificent golden yellow-flowered *Tabebuia Guayacan,* and here and there tree tops glowed with the blood-red spikes of the handsome liana *Combretum coccineum.* In the vicinity of Pinogana it was gratifying to find ample flowering material of *Aristolochia grandiflora,* although no specimens seen equaled in size the enormous flowers collected at Yape in 1937, and destroyed in our tragic fire of that year.

The village of Yape had changed little since my last visit, except that the thickets which had harbored the fine Aristolochias had been cleared for agriculture. Thatched houses of the blacks in a barren clearing on the north bank face the stilted thatched homes of the Indians on the south, the latter attractively set among trees. On crossing over, we were received with dignified reserve by a middle-aged Choco man, clad only in a scarlet loin cloth, who invited us in his halting Spanish to climb the notched log stairway to the living platform of his home. The season's harvest had been recently gathered, and we found great clusters of rice heads suspended from



Native boy holding flower of *Aristolochia grandiflora*



Choco Indian house, Yape, Upper Darien Province

the rafters, and bushels of corn in the husk stored in huge circular bins made of the bark of the Balsa tree *(Ochroma limonensis)*. In addition to the common yellow corn grown in much of Panama, he had two curious red and brown types not previously seen. Although he insisted that all were purposely kept and grown as distinct varieties, his meager Spanish broke down on questioning as to specific uses. Samples and photographs were obtained which have been sent to Dr. Edgar Anderson, the Garden's Geneticist and authority on tropical American corn, to be added to his extensive collections. All in all, some 200 plant specimens were obtained, which have been forwarded to St. Louis as additions to our limited knowledge of the flora of this isolated area.

In June keep your eyes open for the Cancer-root, *Orobanche uniflora.* It is a parasite without any green coloring matter and its amber stems bear attractive light-colored flowers.

The Partridge Berry, so common in New England woods, does grow and flourish in Missouri, though comparatively few people ever see it here. With us it is restricted to moist, shady habitats in little rocky canyons.

BETTER FORSYTHIAS FOR ST. LOUIS

EDGAR ANDERSON

Forsythias are outstanding in the early spring garden because they last. Other spring shrubs may be even more effective in the landscape, but they are here today and gone tomorrow. If the weather is at all warm, Japanese Cherries are seldom in flower more than a week or ten days in St. Louis, and lilacs can be even more fleeting. But early spring or late spring, dry or wet, Forsythias can be counted on for several weeks of spectacular bloom.

Forsythias are all pretty much alike, yet there are two choice varieties *(F. viridissima* var. *koreana* and *F. intermedia* var. *primulina)* which are almost never seen in St. Louis gardens though both of them take very well to our climate. The Korean Forsythia has slightly smaller flowers than the common kinds and the bush is lower and denser. It blooms just a little in advance of the rest; in early springs perhaps only a day or so earlier, but in late springs, like the present one, it may be a week or ten days ahead of all the others.

Several named varieties of Forsythia have appeared upon the market. The variety *spectabilis* is a large but nicely formed bush and is very thickly set with big, brilliant yellow flowers. It is a kind of super-Forsythia and is already becoming widely planted in St. Louis. Hardly any one here, however, seems to have heard of the equally interesting variety *primulina.* It is similarly shaped and nearly as floriferous but the flowers are a soft primrose yellow as the name indicates. As a background for spring-flowering bulbs and early Iris it is almost without a peer. The soft light yellow makes the perfect setting for bright-colored spring bulbs such as hyacinths and early tulips.

Did you ever need a strong piece of string when on a hike in the country? An effective substitute can be made in a few minutes from the bark of almost any of our larger milkweeds.

Transplanting Irises.—The best time to move nearly any Iris is shortly after it blooms. If you will pull up an Iris plant then and look at the roots and rhizomes you will find that they are starting out vigorously in new growth. Transplanted at this time, one gets the advantage of all the strong new roots. The tall-bearded irises can be moved during almost any part of the growing season if they are not kept out of the ground very long and if extra care is taken in moving them. Right after blooming they are not so sensitive. They can be dug up almost casually and left out of the ground for a day or more with no apparent damage.

NOTES

NOTICE: Requests are frequently received for back numbers of the Bulletin, many of which are now out of print. If you have any back issues, regardless of the number or date, and have no further use for them, please return them to the Garden. The postage will be promptly refunded.

A woodcock was observed in the City Garden on several occasions in April. This interesting bird is seldom seen in the city.

Dr. Gustav A. L. Mehlquist, Research Horticulturist to the Garden, has been awarded a Guggenheim Fellowship to study in England this summer.

Work has begun on the installation of an elevator in the Administration Building of the Garden, to be located at the north end of the Library-Herbarium.

The annual flower sermon, provided for in the will of Henry Shaw, was preached at Christ Church Cathedral, on Sunday, April 20, by the Rt. Rev. Austin Pardue, D.D., Bishop of Pittsburgh.

Both at the Arboretum and the City Garden the White Redbud has flowered well this spring. It gives a particularly pleasing color contrast in those spots where it has been interplanted with the ordinary redbud.

Tulips are back again at the Garden, and the unusually cool spring has brought them into almost perfect development. Another plant which is flowering well in the Knolls this year is the Imperial Azalea, *Rhododendron Schlippenbachii.*

Among recent visitors to the Garden were Dr. Barry Commoner, of New York City, formerly Biological Editor of *Science Illustrated;* Miss Alice Dustan, of New York, Garden Editor of *House Beautiful;* Father George H. Link, of Michael, Ill., formerly Naturalist at Pere Marquette State Park, Godfrey, Ill.; Dr. R. C. Allen, Secretary-Editor of the American Rose Society; Dr. William L. Brown, Geneticist, Pioneer Hi-Bred Corn Co., Des Moines, Iowa.

Mrs. John Riordan, of St. Louis, recently presented to the Garden an old scrapbook which was given to her grandmother, Mary Emma Harris, by Henry Shaw, about 1868. The book contains carefully pressed specimens of the flowers then growing in "Shaw's Garden," some of which are individually mounted and some in designs of wreaths, hearts, and sprays. The collection is not only of historical interest as a Shaw relic, but also is of great horticultural value because accurate lists of plants growing in gardens of that period are extremely rare.

THE MISSOURI BOTANICAL GARDEN

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN

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Cover: Linnean House Garden in the spring.

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Missouri Botanical Garden Bulletin

Vol. XXXV JUNE, 1947 No. 6

WOOLLY BUCKTHORN FOR HEDGES

ROBERT B. CLARK

During the spring of 1939 ten young plants of *Bumelia lanuginosa* var. *oblongifolia* were dug up from the wild and set out in the hedge demonstration plot at the Garden. They did not establish themselves readily, so the following spring eight seedlings were interplanted with them. The seedlings soon overtook the older plants, and now it is difficult to distinguish between them. Today the hedge is compact and stands three feet high. The rate of growth is comparatively slow, last year the hedge being sheared only once and in other years not more than twice during the season.

Though the Woolly Buckthorn seldom exceeds 20 feet in height, its growth habit is such that it will tolerate shearing. Irregular in outline, like the hawthorn, this tree has two types of branches—terminal ones that zig-zag with alternate leaves, and lateral ones that develop short shoots on which leaves are fascicled (in bunches). Moreover, the dense branches are armed with stout thorns among the glossy leaves. Another feature that makes the Woolly Buckthorn appropriate for hedges is its capacity for withstanding hot, dry situations. Frequently hedges are planted along walks or driveways where the summer sun beats down onto the pavement, generating intense heat, and where automobiles whizzing by swish the foliage into browned shreds.

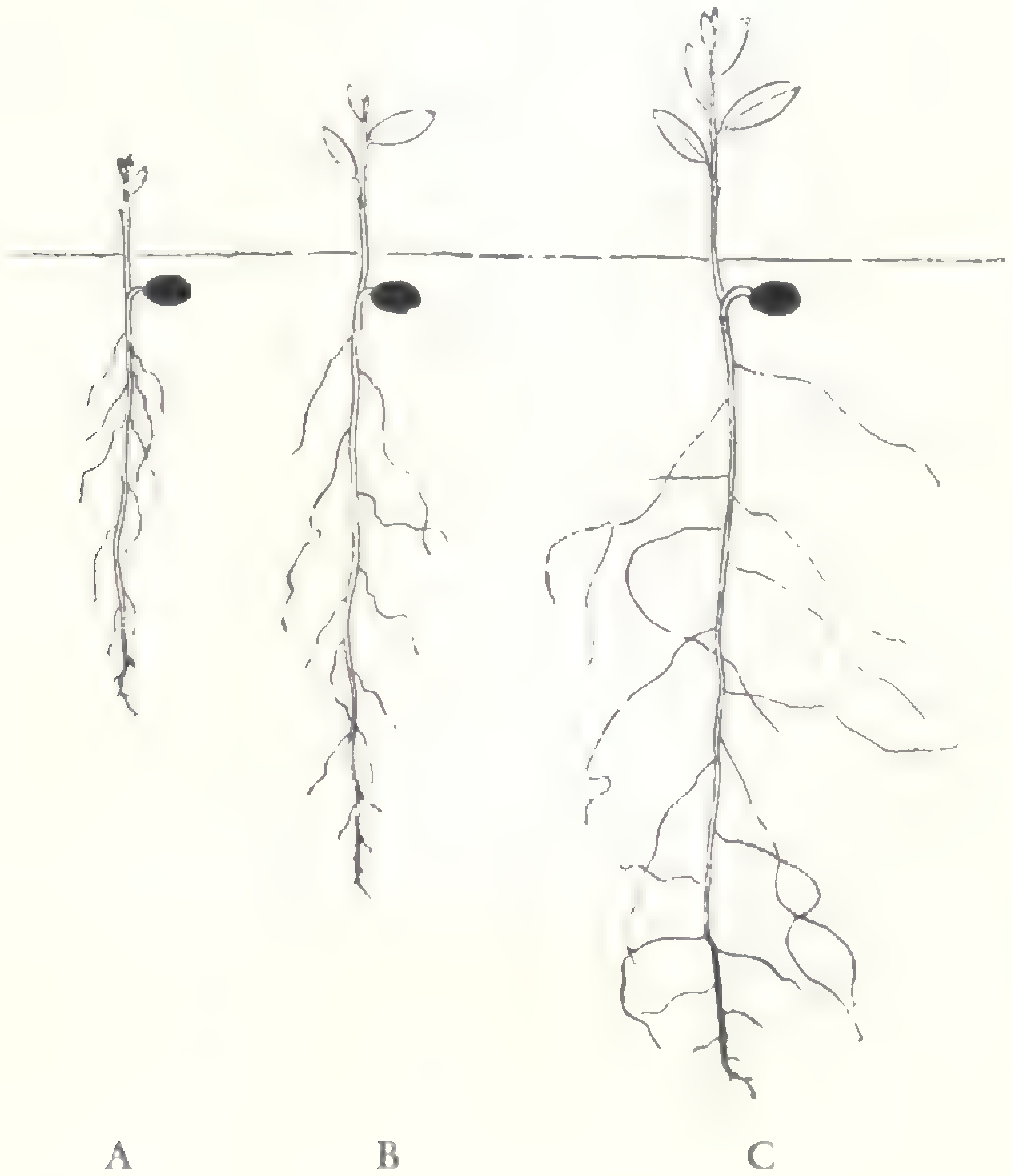
The question may be asked, "where has the Woolly Buckthorn been all these years?" It has been growing unobtrusively in the dry, rocky Ozark uplands—the glades, knobs and bluffs. This plant and its close relative, the Southern Buckthorn or Ironwood, *Bumelia lycioides*, are the hardiest species of this predominantly tropical American genus. *Bumelia* belongs to the Sapodilla family whose milky latex is known commercially as chicle, the base for chewing gum. Indeed, one of the popular names for this species is Gum Elastic, alluding to its gummy sap. It is also commonly called

Chittimwood, but bears no relationship to the chittim of Biblical lore (which is *Acacia Seyal*). No doubt this name is applied because of its hard, close-grained, yellowish-brown wood which suggests the ancient chittimwood. The more generally accepted common name, Woolly Buckthorn, is derived from the superficial resemblance of the small tree to the common buckthorns (*Rhamnus* spp.), while the adjectival name refers to the woolly appearance of the young leaves.

Woolly Buckthorn *(Bumelia lanuginosa* var. *oblongifolia)* in hedge demonstration plot at the Garden.

Bumelia lanuginosa was first collected in the forests of Georgia by the elder Michaux about 1800. Approximately twenty years later Nuttall, exploring for plants along the Mississippi River, came across specimens of the present, more widely distributed variety in Arkansas which he called *B. oblongifolia.* More recent botanists have recognized the similarity of these species, some calling them identical, others considering Nuttall's plant a variety of the older species—thus *Bumelia lanuginosa* variety *oblongifolia.*

In its native habitat Woolly Buckthorn thrives when other trees succumb. Even at a temperature of 100° F. the leaves do not wilt appreciably. The reason for this reaction in such marginal situations is not hard to see. If one has ever tried to transplant this shrub when it is only about two feet tall, he no doubt found an exceedingly long tap-root. On the rocky limestone glades the young plants send their roots far down into the crevices in search of water. Newly germinated seedlings give a clue as to what to expect (see cut).



A and B, seedlings germinated in soil mixture consisting of equal parts of sand, peat moss, and loam. A, from pan kept in cool greenhouse; B, moved to warmer range; C, seedling germinated in soil mixture consisting of equal parts sand and peat moss and placed in warmer range. Drawings ⅖ natural size.

The seedlings pictured above represent the variation in size and vigor according to three methods of seed propagation. The seedlings on the left (A) and in the center (B) were started in soil preparations consisting of equal parts of sand, moss peat, and loam. The pan containing seedling A was left in a cool greenhouse (temperature 55-60° F.), while that of seedling B, after 6½ weeks, was removed from the cool greenhouse to a warmer range (62-75° F.). Seedling C (right) received better treatment, for its seeds were sown in equal parts of moss peat and sand and started in the warmer ranges. The time between sowing and germination of the first seedling of C was 4 weeks, as against 8 weeks for B, and 11 weeks for A. Moreover, percentage of germination was greatest for the "C" group, 58 per cent; "B" group, 56 per cent; and the "A" group, 42 per cent.

Plants of Woolly Buckthorn have never been available in nurseries, and it is difficult to obtain seed because this tree does not bear seed every year. However, if it is possible to secure young plants, no better material could be suggested for hedges in dry, hot situations once the plants become established. The fragrant, but small, midsummer flowers, black berries in September, glossy leaves that turn reddish-bronze late in autumn, and the dense branch pattern make it an interesting plant throughout the year.

THE FABULOUS 2-4-D

ROBERT W. SCHERY

Within the last several years much attention has been focused on that "magic weed exterminator" 2-4-D. No weed killer before it has been so easily handled, so accessible to the amateur, so relatively cheap, and finally, so selective in killing noxious plants of the lawn while permitting most grasses to grow unharmed. Within a short few years 2-4-D has been highly publicized and advertised, offered for sale under innumerable brand names, and used by a goodly portion of the neighbors in every one's block. Yet in spite of all this, it is surprising how few of its users understand what 2-4-D is, and especially how it works. Thus it may not be out of place to add to the already impressive array of articles that have appeared on the subject a simplified epitomization of what the experts say about 2-4-D.

The term "2-4-D" stands for the chemical compound 2-4-dichlorophenoxyacetic acid. No wonder then that it is simply called 2-4-D. A number of other related chemical compounds, producing very similar results to it, have also been synthesized. Various of these may be incorporated in some of the "2-4-D" solutions on the market. All such chemicals are a special kind of "growth hormone," that is, a substance which in very minute quantities will stimulate tissues or cells to exaggerated or unusual "growth." Almost every one knows that the human body is in part regulated by hormonal secretions from various glands, such as the thyroid or adrenal glands. These, at least in part, regulate growth and development from the child to the adult. Similarly, it has been shown that development in plants is at least partly controlled by hormones secreted by such structures as growing stem tips or terminal buds. Very small amounts of these secretions are effective in altering or maintaining the growth pattern of the plant. And, much as uncontrolled or uncoordinated hormonal activity within the plant might cause unusual "growth" upsets in various cells and tissues, so 2-4-D acts when applied externally. Applied to any portion of the plant, it seems to be rapidly transmitted through the tissues to all other parts in sufficient strength to cause characteristic "hormonal effects." When leaves are sprayed with 2-4-D, as is commonly done, even the roots eventually die. Perhaps this chemical, not formed naturally in plants, should be termed a growth-regulating substance rather than a hormone.

The experts show us that growth-upsets in the plant after 2-4-D applications in recommended herbicidal dilutions can be described much as follows. The upper stems and growing parts seem to add rather uncoordinated extra layers of cells to certain tissues. Also cells of several types become unusually large. This increase in cell size and cell number tends to break proper contact between tissues of the various parts of the plant, and probably inhibits proper "circulation" of food and water to many of the tissues. Meanwhile, living cells seem to "live at a faster pace" under the effect of 2-4-D—that is, they are stimulated to carry-on their normal activities more rapidly than is usual. With "decreased circulation" coupled with an apparent inability of most cells to form reserve foods in the presence of 2-4-D, the physiological activities of the plant continue at an increased rate and it soon exhausts itself. It seems unable to make the necessary green pigment, chlorophyll, and turns yellow, wilts, curls or twists, and eventually dies. Since exhaustion of many cells may take days or even weeks (depending upon the type of plant, the season, and many other factors), the results of a 2-4-D application may not show for some time.

When 2-4-D is applied to the lawn in the St. Louis area according to directions on the bottle the most rapid and pronounced results seem to be against plantain (Plantago). Within two days its leaves begin to curl, turn yellow, and the plant becomes a distorted, dying remnant of its former robust self. Chickweed (Stellaria) likewise yellows and dies, but in my experience not so rapidly as does plantain. Dandelion (Taraxacum) appears to be much more resistant to 2-4-D in the spring than does chickweed or plantain. Older dandelions succumb to 2-4-D within a week or two, showing symptoms similar to those of treated plantain, while others (apparently younger ones not yet flowering, and not mature enough to respond physiologically to the chemical) seem to be relatively uninhibited after several weeks. My experience also indicates clover to be relatively more resistant to 2-4-D than plantain or chickweed, especially during summer months.

The unique value of 2-4-D resides in the fact that grasses and related plants are not affected by the chemical. Apparently physiology in grasses is not upset by the presence of this growth-regulating substance to the extent that it is in the broad-leaved plants. Thus 2-4-D is selective in what it kills, and enables us to eradicate many lawn weeds without injuring the grass. Many herbicides have been known which will kill weeds, but unfortunately they also kill grass. Only with discovery of 2-4-D did science come upon a lazy man's technique for keeping up the lawn. In fact, on the market today are fertilizers containing not only nutrient elements but also proper quantities and forms of 2-4-D, so that a single spring application both encourages the grass and kills most of the weeds.

In spite of its abundance and ease of application (most 2-4-D preparations come in liquid form to which only a measured quantity of water need be added), 2-4-D is an insidious chemical to let loose in careless hands. Applied during a windy day it may be carried from the lawn to near-by shrubbery which may be killed or injured by even small quantities of spray. Once a pressure sprayer or sprinkling-can has been used for 2-4-D, it may contain enough residuum of the preparation to kill plants when used again for normal watering or spraying. Moreover, very little is yet known about the cumulative effect of 2-4-D, or whether or not after protracted use it may have certain disadvantages or harmful effects. The scientist has shown us that 2-4-D applied to a fruiting plant may be "carried-over" in the seed, affecting adversely the succeeding generation. Of course, the most inhumane use of the chemical could come in wartime, where enemy crops could be destroyed by "chemical warfare." During the recent war most of the top experts on 2-4-D in the United States were on Government projects as secretive as was the Manhattan Project, and detailed results of the work have not been released, if ever they will be.

The efficacy of 2-4-D can be appreciated when it is realized that the acid is toxic to plants in concentrations as low as $\frac{1}{10}$ of 1 per cent. That is, 1 cc. (about 1 teaspoonful) mixed with 1000 cc. (about 1 quart) of water is of sufficient strength to kill most broad-leaved plants. However, 2-4-D may also be applied as a dust or in the form of a salve. Dusts have proven less effective than have liquid solutions, and salves are only of use for application (in heavy concentration) to unsprayable plants such as trees. Trees to be killed by 2-4-D must have a section of bark removed and the salve applied directly to the inner living tissues. 2-4-D may also be of use in pre-treating soils against eventual weed growth. Soil in which proper concentrations of 2-4-D have been mixed will be free of most weeds for at least several weeks, while grass-like plants will germinate and not be adversely affected,—may even be somewhat stimulated to better growth by the 2-4-D.

In turf maintenance the most effective way to apply 2-4-D is usually by the liquid solution. Application in the spring or autumn is probably better in the St. Louis area than in summer, since during these seasons blue-grass is actively growing and will take over most of the bare spots left by dying weeds. Weeds eradicated in summer will likely be replaced by the pestiferous crab-grass, which reaches its peak of activity at that season while blue-grass is not actively growing. On the other hand, dandelions are reported more resistant to 2-4-D in the spring (before flowering) than later, and clover is more susceptible to 2-4-D in spring than in summer. Also, certain weeds are less susceptible at lower (spring) than at higher (summer) temperatures. Thus intelligent turf maintenance must take into consideration which weeds are predominant and at what season the desirable lawn components (usually blue-grass in the St. Louis area) can best be encouraged at the expense of the weeds. In any event, judicious use of 2-4-D is a boon to many a home-owner previously harassed by dandelions, plantain, and their brethren of the weedy lawn.

Redbud, Cow pastures and Beer Barrels.—

Redbud in Missouri is naturally a plant of the wood edges. It is seldom found deep in the shade but makes a line of rose-purple around a cliff or along a road. If, for any reason, a heavily wooded area has considerable sunlight let in among the trees one may expect the redbuds to follow the sun into the woods after a few years. Motoring through Missouri in the height of the spring, it is easy to see the relation between redbuds and land use. When a piece of woodland is cut over and pastured for several years, thickets of rosy pink come in among the second growth, and it is usually easy to see that the redbuds are thickest close to barns and feeding sheds.

The importance of St. Louis as a brewing center has led to the cutting of mature oak trees for "tight cooperage" mills, where they are made up into beer barrels. It has been a common practice, particularly on dry hill-sides, to go through the woods and cut out the larger oaks, leaving the rest of the forest substantially untouched. If these woodlands already have a little redbud to serve as seed trees there is a great increase of them for five to ten years after the oaks have been cut. Just as opening the woodlands will encourage redbud, so thickening them up will discourage it. When the Garden purchased its Arboretum at Gray Summit there were included in the area a number of wooded tracts which had been so heavily pastured that they were very bright with redbud every spring. Soon after the cattle were withdrawn and these places were encouraged to go back to forest, the redbuds started to die back and are now nearly all eliminated except around the edges and along roadways where they blossom in greater perfection than they did before.

E. A.

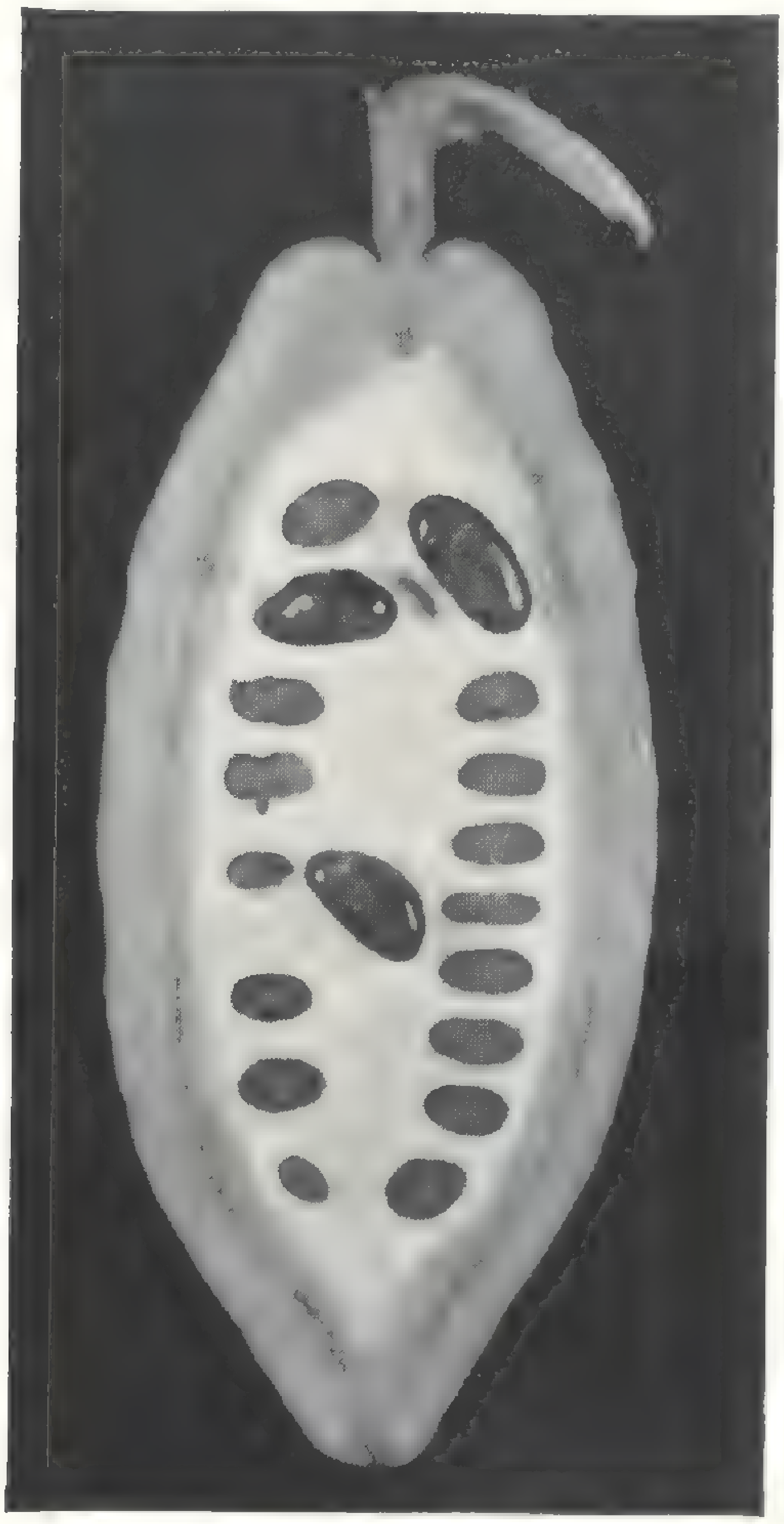
CHOCOLATE

PAUL A. ALLEN

When we enjoy a cup of hot chocolate on a cool afternoon, munch a chocolate bar, or relax by the radio and reach for a chocolate cream, few of us stop to consider that this rich, quick-energy food-confection was not always on Everyman's table. Fewer still would recognize the plant from which it is obtained for chocolate is produced from a tree of the deep tropics and few who have not visited the wet, warm lowlands of countries near the equator have ever seen it. Although much of the world's crop today comes from tropical Africa, the tree is a native American. De Candolle thought that its home was probably in the basin of the Amazon, or the Orinoco, but primitive Indian agriculturists had watched its tiny flowers transform into plump golden pods, filled with stimulating, nourishing seeds, and had scattered it far and wide, from Peru to Mexico, in pre-Columbian times.

Flowers and young fruit of the Chocolate Tree *(Theobroma Cacao)*.

Although chocolate in its many prepared forms ranks today as Big Business, it was not immediately recognized as such by the first Europeans. It is, perhaps, too much to expect that a man be wiser than his time, but it is interesting to speculate on how closely fortune can sometimes pass, and yet remain unrecognized. Columbus, in 1502, on his fourth, and last, disastrous voyage to the New World, seeking shadowy Asiatic kingdoms, captured a great sea-going Mayan trading canoe off the north coast of Honduras. He looked in vain among the various items of cargo for one evidence of that wealth which would justify the expense of his voyages in the eyes of Spain. There were only textiles, copper axes and bells, pottery jars filled with a maize beer, and a considerable quantity of some strange "Almonds" which the Indians seemed to set great store by. How could he know, as he fingered the curious bean-like seeds and as the excited crews of both vessels stared and gabbled incomprehensibly at each other, that here was the foundation of a plant industry which would some day produce annually more than the entire loot of all his voyaging?



Fruit of *Theobroma Cacao* split lengthwise to show seeds within. About half natural size.

Seventeen years were to pass before Europeans saw chocolate again, but this time there could remain little doubt in their minds as to its importance to the American Indian. Bernal Diaz, one of the soldiers who followed Cortez on the conquest of Mexico, tells us that the Aztec Emperor, Montezuma, consumed the contents of fifty golden goblets of chocolate daily, prepared in the Indian manner, mixed with vanilla or other spices, beaten to a froth, and served stone cold. Torquemada asks us to believe that the royal household used over 200,000,000 pounds of chocolate yearly, and while such a figure is obviously preposterous nevertheless the seeds were an important item of tribute, passed everywhere as a sort of currency, and were to the nation of tremendous economic importance.

Cortez, a superb showman, brought a quantity of the seeds with him on his triumphal return to Spain in 1520. Besides describing its use by the Mexicans, he did not neglect to suggest that such a marvellous food, combining nourishment with the stimulating effect of an alkaloid, must have been created expressly by the Divine Providence, and that it had doubtless been one of the trees of the Garden of Eden, placed there for the enjoyment of man. Perhaps influenced by this sage opinion, the great Linnaeus, when he described the plant in 1735, called it *Theobroma*, signifying "Food of the Gods," with the specific name *Cacao*, as most nearly approximating the unpronounceable Aztec name of "*Cacahoatl.*"

Fruit of Chocolate Tree *(Theobroma Cacao)*

It is not known when sweet chocolate, served hot, as we now know it, was first made, but this marked improvement over the bitter, frothy cold Mexican drink appeared sometime during the sixteenth century while Spain held a tight monopoly on the use of chocolate. In the homeland and in the colonies, the drink became so popular that it produced learned discussions among high authorities of the church as to whether it might properly be taken on fast days, since it was nourishing. Fashionable ladies of Chiapas had chocolate served them during church services, to the scandal of their good Bishop, who passed an edict prohibiting such worldliness. Such a popular drink could not long remain the exclusive property of any one country, and by 1657 Samuel Pepys in London could record in his diary, "To a coffee house to drink jocolatte, very good." Today the world enjoys the "Drink of the Gods," and whole generations of masseurs rise up to call it blessed, as they rub away the extra pounds on customers who could not resist another chocolate mint.

Wisteria and Dogwood.—

It almost seems as though the dogwoods, both native and cultivated, put forth an extra effort this spring to make up for the delayed arrival of warm days, or perhaps the general paucity of blooms through early May made them seem especially welcome. At any rate, their snowy splashes of pure white through the woodland borders and county gardens added a measure of hopefulness that summer was really just around the corner.

The incomparable brilliant white of the common flowering dogwood knows no competition from other trees at any season but when this is combined with the pink-flowering variety the two complement each other in a way that is unequalled by any other two trees. Quite a few county residents have realized the possibilities in this startling yet mellow union of colors and have planted them within 20 or 30 feet of each other. Some thought must be given to the fact that before many years they may be close to topping the house but the late spring show will go on unabated, and in a region where oaks, with all due respect to their many advantages, are sometimes a bit monotonous the dogwoods are not to be thought of as merely a "flowering tree" and forgotten the rest of the year. Although not so symmetrical in their later years, they may supply a much-needed spot of shade through the summer, and the leaves in autumn will hold their own with any of our native trees and shrubs for a last splash of color on the landscape in fall.

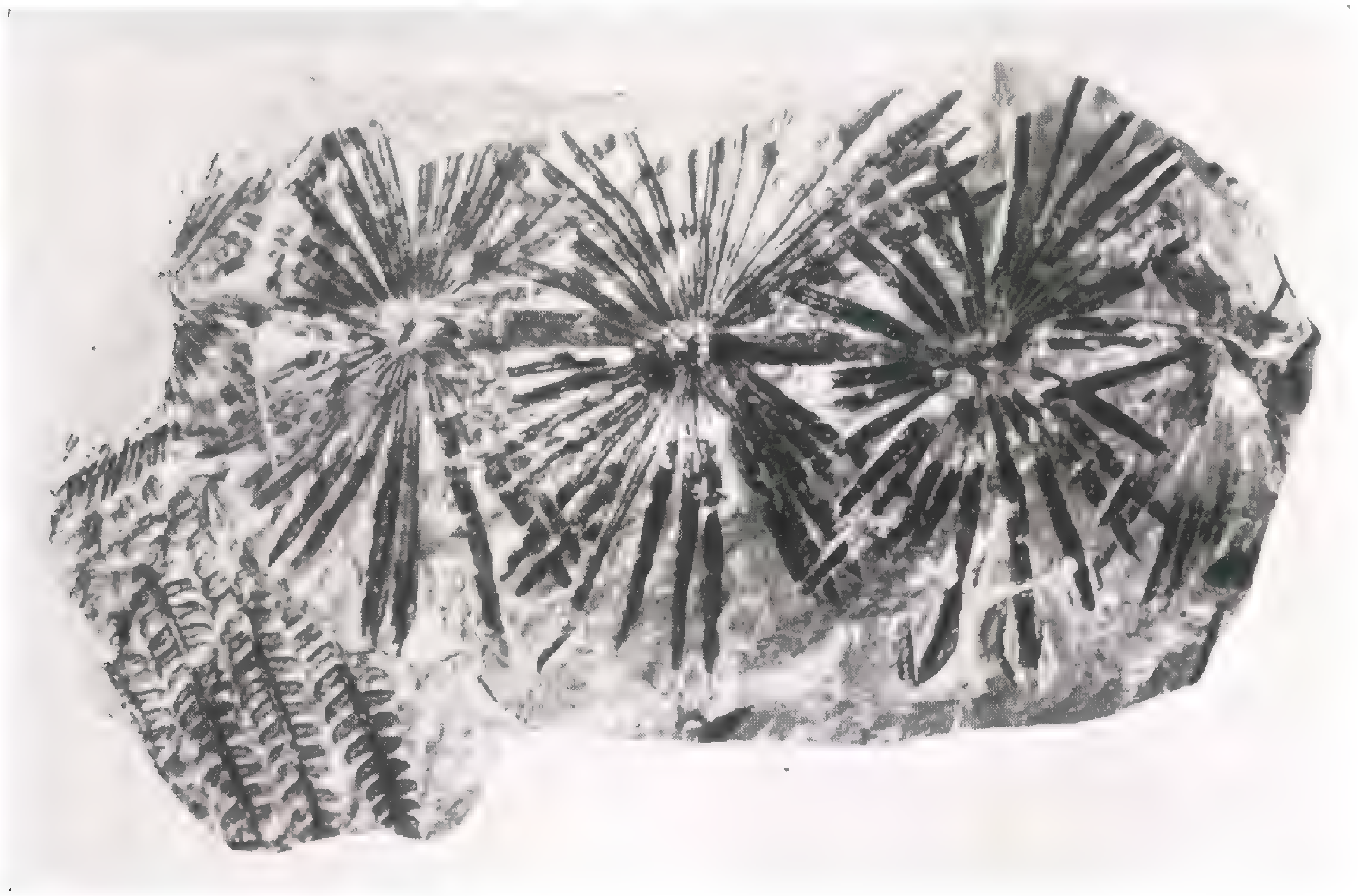
Although the likelihood of improving this pink and white melody might seem like a horticulturist's dream, a few garden enthusiasts have done it—by combining a tree wisteria with the two dogwoods. The wisterias too have given a good account of themselves this season in most gardens, many being covered with great solid masse of soft lilac sprays. When one of the tree wisterias is planted within a few yards of a pink and a white dogwood, a show of truly American hues is produced that will be long remembered. Ordinarily the dogwoods may be expected to appear somewhat ahead of the wisterias although this season the former were delayed just long enough so that the blooming of all three coincided. But even in a normal season—if we ever should be confronted with such a miracle—the pink and white of the dogwoods will blend into the lilac-blue of the wisterias, lending a charm to your garden that will be the envy of the neighborhood.—H. N. A.

PLANTS OF YOUR COAL BIN

HENRY N. ANDREWS

To those who are more than casually interested in the plants of past geologic ages the great strip mines of northern Illinois constitute a veritable Mecca. Located about 60 miles southwest of Chicago, it is one of those unusual areas where some measure of success can be depended upon with every visit. In the winter or spring you may freeze in a cold drizzling rain, or you may bake in the summer sun, "picking fossils on the spoils," but there will be something worth while to take home at the end of the day—a few mementos of the forest plants of the Coal Ages.

The story of these curious fossils goes back at least four or five decades when geologists began to find distinctive oval-shaped rocks in the bed of Mazon Creek, a small stream that flows through that part of Illinois. These vary from the size of a kidney-bean (and they have pretty nearly the same shape too) up to specimens a foot or more long. When they are hit with a hammer on the thin edge they generally split open like the two halves of a bean, revealing the impression of a fern leaf, a seed, stem, or some other fragment of a plant—and more rarely animal remains such as insects, crustacea and fish scales. These nodules or concretions are a rusty red in color, and being appreciably harder than the sedimentary rocks in which they are found they are much more resistant to weathering.



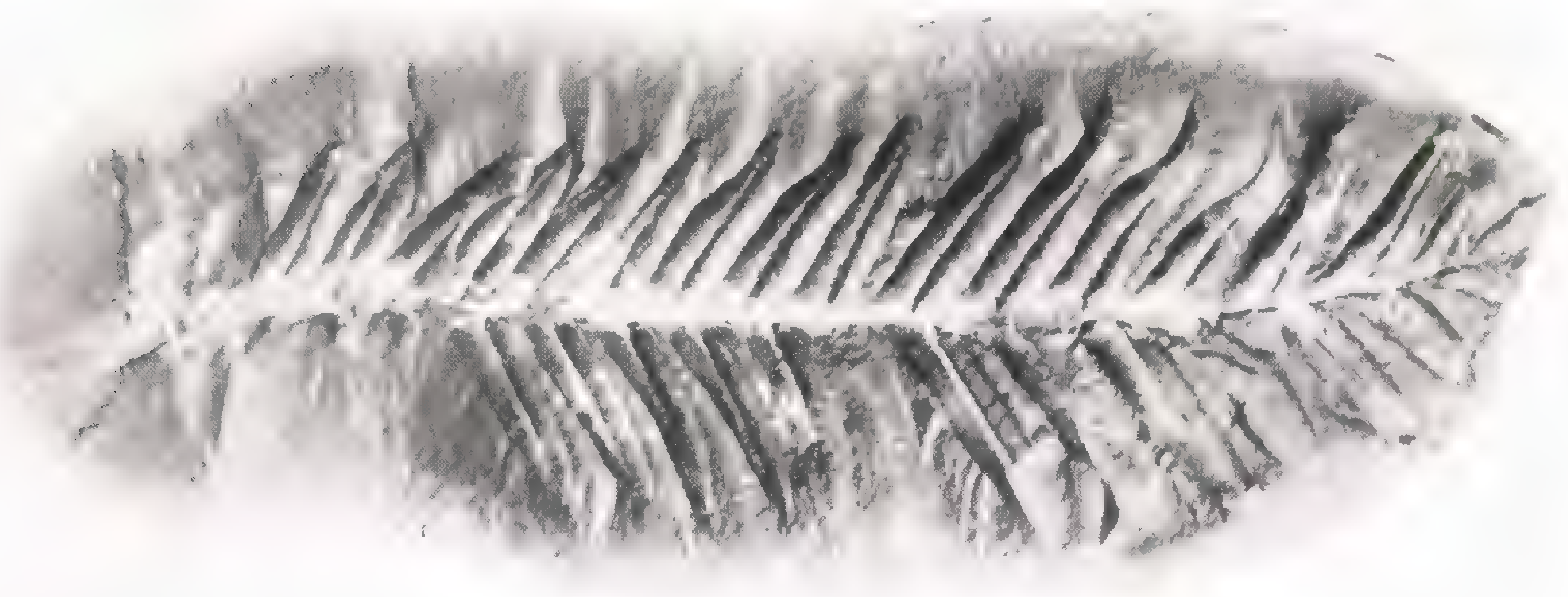
Foliage of the Calamites—giant Horsetail Rushes of the Coal Age

For many thousands of years great forests occupied this general region and the plant debris that was shed each year accumulated in swamps, eventually being consolidated into coal. Later a vast embayment of the sea crept in covering the swamps. Plant fragments, however, continued to drift in with the muds and silts which later developed rock formations over the coal seam. These sediments accumulated about the bits of leaves, seeds and stems and became impregnated with oxide of iron which lends the characteristic color and hardness. When they contain but a single specimen the nodules may be singularly beautiful, while others contain badly broken fragments (fossil plant "hash") that are of no interest or value at all.

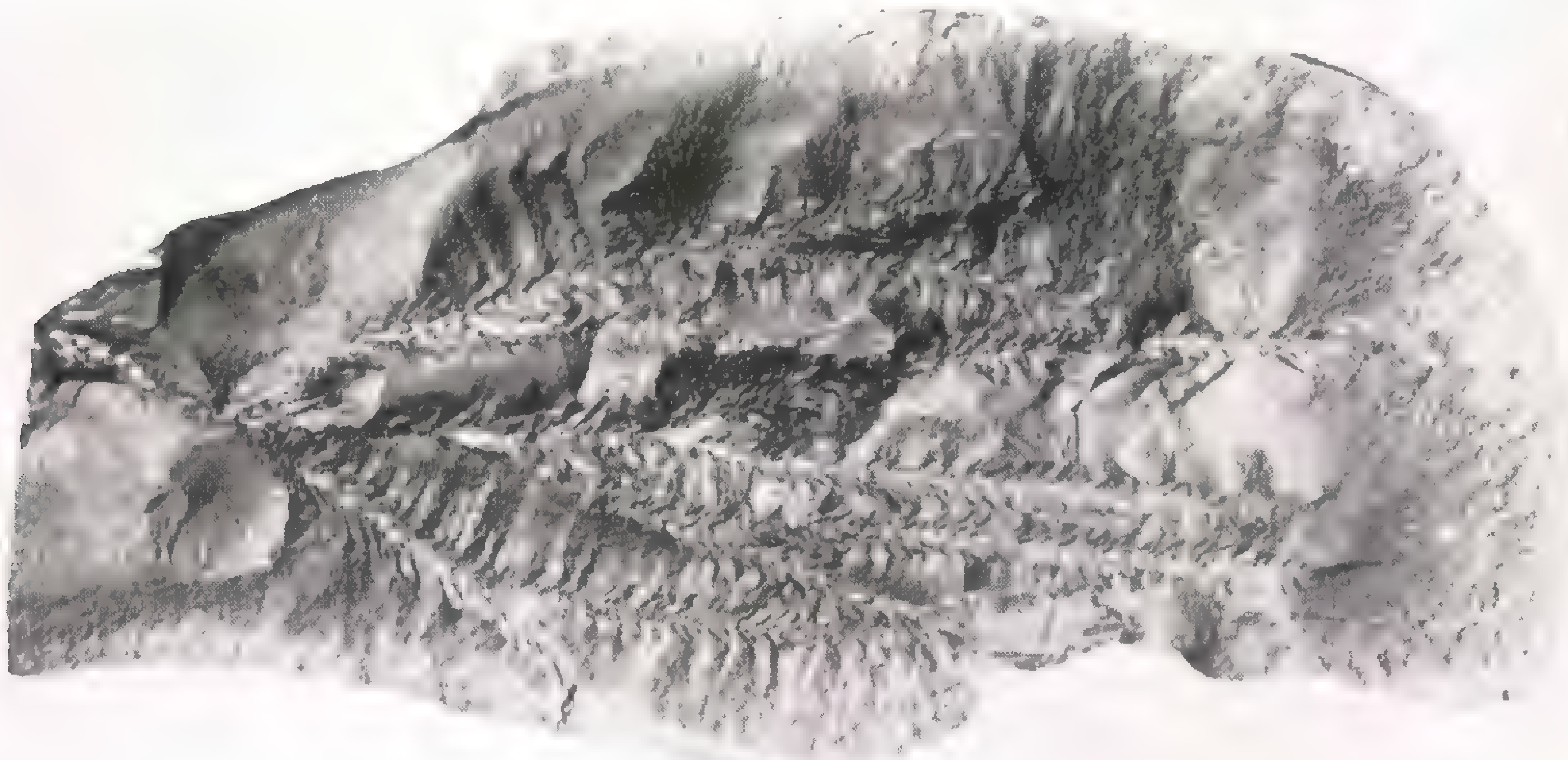
The supply of these nodules in the bed of Mazon Creek was of course rather limited, but in 1927, when the coal began to be mined by stripping operations, they were exposed in abundance. For twenty years now giant electric shovels, biting out as much as 32 cubic yards at a time, have been exposing the coal vein which lies 50 or 60 feet below the surface. Topographically, the result has been the creation of a rather extensive "bad-lands" area, which has created a good deal of controversy among agriculturists, conservationists and the coal-mining interests. But whatever may be the sum total of the economics involved, we have learned a good deal about the plants that lived there some 250 million years ago.

Almost immediately after the monstrous shovels scoop up the earth and rock overlying the coal the nodules begin to weather out and one may wander over these dumps, or "spoils" as they are locally known, gather up a few dozen specimens, then seek out a hard rock and pound away with a stout hammer to open the pages of a very old book. Predominant among the plants represented are fragments of fern-like foliage. Some of these are indeed true ferns (spore-bearing), while others belong to an extinct group of plants known as Seed-ferns. Most of these foliage specimens are sterile, —that is they bear no reproductive structures. Occasionally one will turn up with the spore sacs in evidence (comparable to the characteristic "brown dots" found on the underside of modern fern leaves), and these enable us to establish their true identity. In some the spores may be well preserved and can be removed and studied under the high powers of a microscope.

Perhaps the oddest and most fascinating fossils found in the nodules are the distinctive whorls of Annularia. These are the leaves of the Calamites, a great race of Coal Age plants that are ancestors of our modern Horsetail Rushes. The latter are common along stream borders and railroad banks, often forming dense thickets but attaining a height of only two or three feet. Their fossil predecessors, however, were trees of respectable size, up to 40 or 50 feet tall, bearing dense whorls of branches in a characteristic jointed, mechanical fashion. The Annularia foliage was borne on the termi-



Many of the Carboniferous plants with fern-like foliage are now known to have borne seeds and are called Seed-ferns.



Lycopodites—a plant related to our modern Clubmosses

nal branchlets which must have presented a superficial resemblance to the common Bedstraw (Galium) of our modern woodlands.

Among the largest and most abundant of the forest trees of these ancient swamps were the Lepidodendrons, the ancestors of our modern Clubmosses. The Clubmosses of today are rather scarce in the Central States, but through the Appalachians, from Georgia to Maine, they carpet the woodlands with their evergreen verdure and are favorites for weaving Christmas wreaths and other Yuletide decorations. It is a long road from these diminutive moderns, resembling miniature pines, to their arborescent Coal Age relatives, but they are sufficiently alike to indicate a great although somewhat declined group of primitive plants.

These distinctive fossil plants found only a few hundred miles to the north have revealed a great deal about the vegetation of long ago. They tell us that many millions of years ago, instead of the oaks, hickories and sycamores, fields of corn and oats, the Ferns, Horsetail Rushes, Clubmosses and early seed plants grew in low-lying swamp lands, and their remains have come down to us in the form of extensive coal deposits and the occasional well-preserved plant fragments in the overlying rocks.

The Trumpet Creeper in Missouri.—In midsummer the Trumpet Creeper *(Campsis radicans)* is so common in Missouri that it sometimes seems as if it ran up every fencepost in the state. Once it gets into plowed ground, pieces of the root are carried to different parts of the field, and nearly all of them sprout up and make new plants. It is almost impossible to get rid of this pest by just plain hoeing. For three years, in one Missouri garden, the Trumpet Creeper plants were hoed out every time they sprouted but at the end of that period they were still coming back month after month. The new chemical weed exterminants are much more efficient in dealing with such a pest.

The Trumpet Creeper's original home in this part of the country was most likely in the flood-plain forests, where it is still to be found climbing high up into the tops of tall trees and flowering there among the branches, much as its tropical relatives do in the Amazon basin. In virgin forests the flowers and seed-pods were probably not as easy to observe and collect as they are today along the fence-rows. The seed pods are most interesting in their own right. They are about six to eight inches long, smooth and stiff as if made from a high-grade plastic. They split open into two parts, releasing hundreds of chaffy seeds which look like little pieces of torn brown tissue-paper. The pods themselves are nearly as handsome as the flowers and in the last few years have sometimes been sold by florists for winter decoration, either plain or gilded.—E. A.

Unless June and July are very dry indeed the Yellow Coneflower or Thimbleflower, *Ratibida pinnata,* is one of the commonest sights along Missouri roadsides. It looks almost like a wilted sunflower since its long yellow ray-flowers always hang down in a limp fashion.

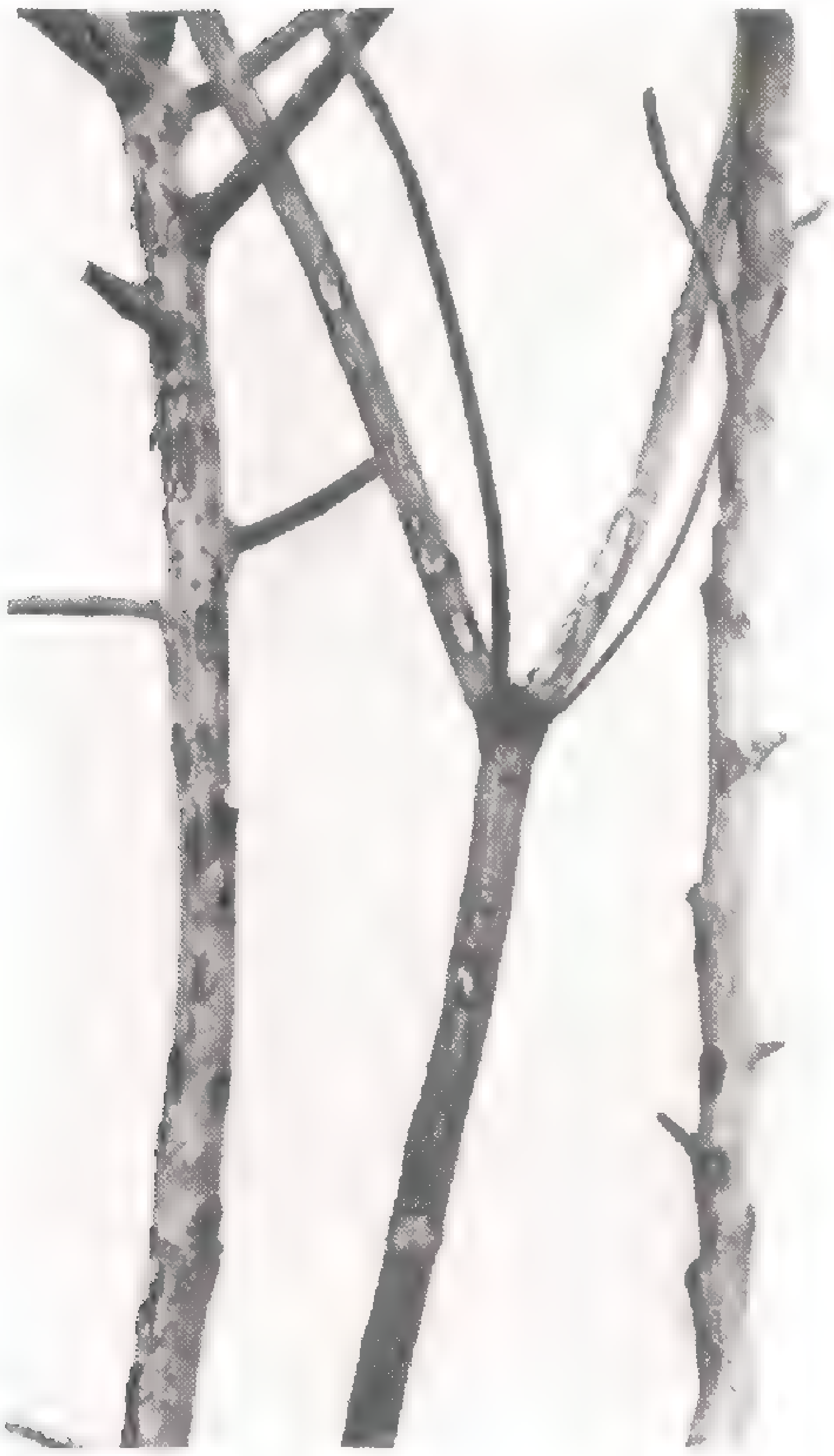
AFTERMATH OF THE SEPTEMBER STORM

A recent letter in the *Post-Dispatch* from a lady in Illinois called attention to the quantity of dead trees and bushes in the Garden, and asked if something couldn't be done about it. While the necessary pruning and cleaning up is proceeding as rapidly as circumstances will permit, it is probable that few people who visit the Garden this spring have any conception of the cause of this unprecedented appearance.

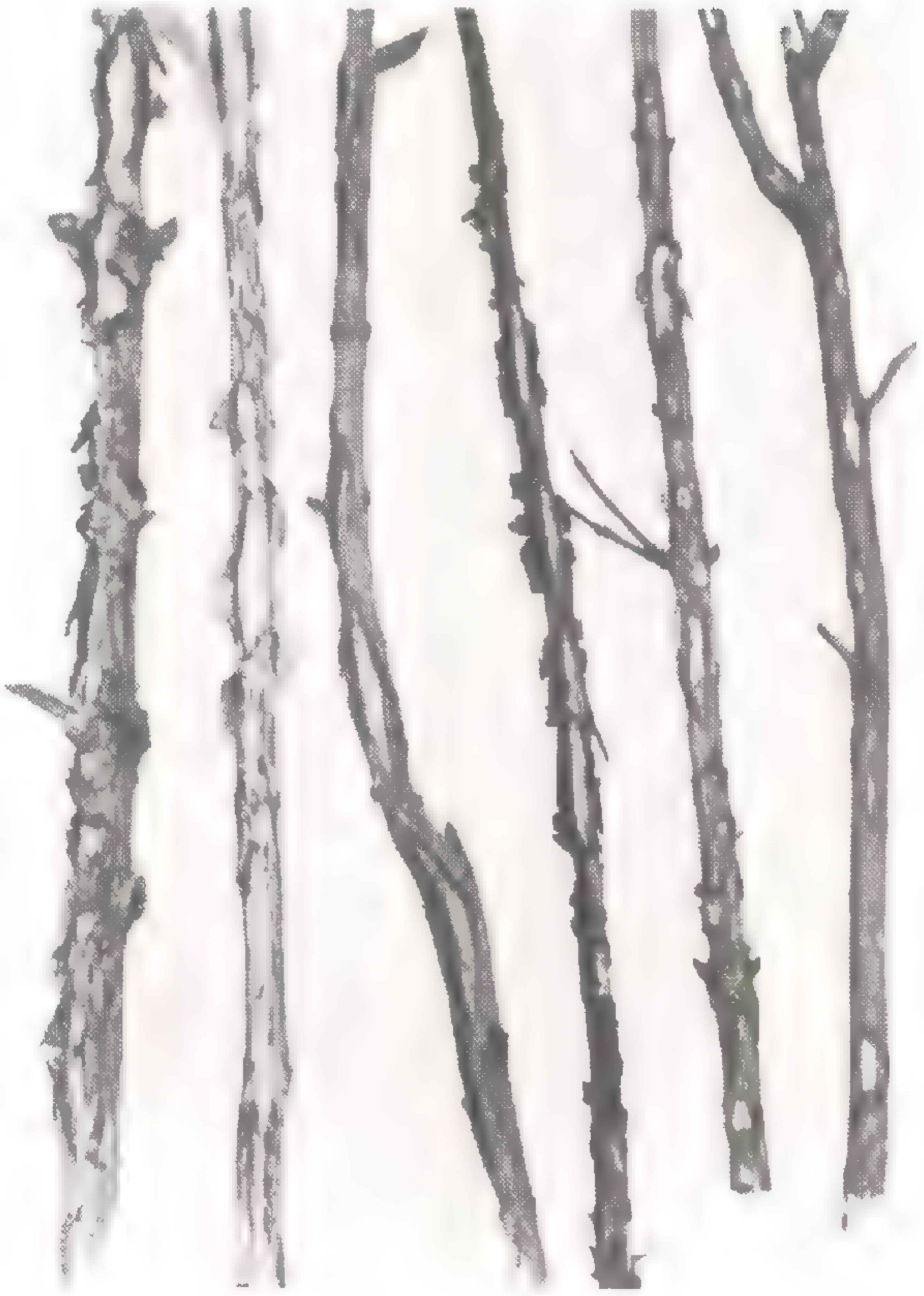
Showing branches of Sumac (at back) and Prunus (in front) killed by September hail-storm.

The wind and hail-storm of last September, referred to in the January Bulletin, was so local in its action that most people in St. Louis were unaware of it. With the exception of a strip through Tower Grove Park no park in the city was touched. The wreckage of large trees and shrubs from the wind alone had to be seen to be appreciated. The closing of the Garden for three days while over 1000 truck- and tractor-drawn loads of litter were hauled away was only the first of many efforts necessary to restore something like order. Some 100 large trees had to be cut into logs suitable for the saw-mill or brush-pile fire, and much pruning of trees and shrubs broken by the wind still remains to be done, but an even greater damage, that could not be appreciated at the time, was the effect of the shot-like hail driven by a 65-mile wind. This is only now beginning to manifest itself through the appearance of innumerable dead twigs and branches. The probabilities are

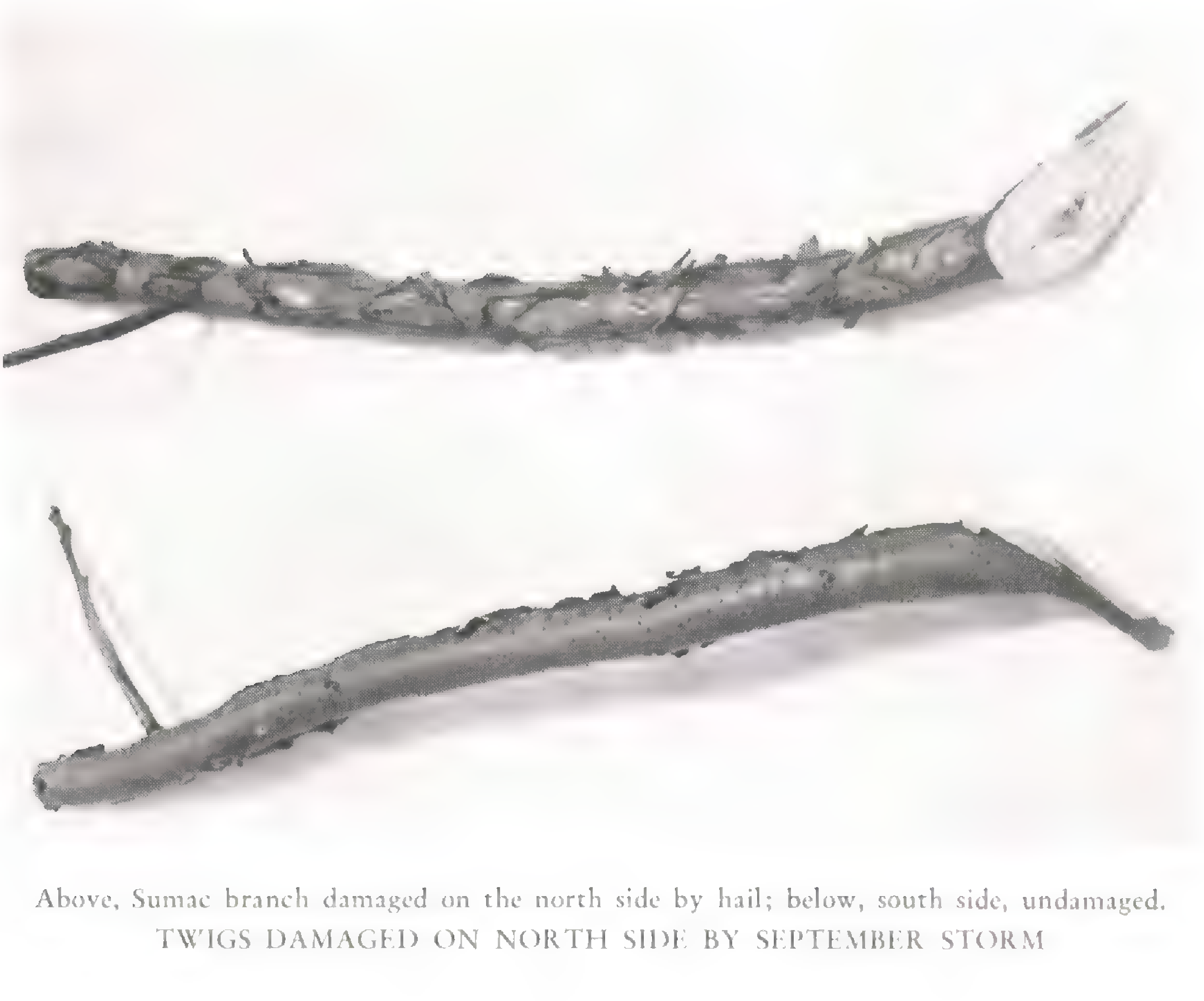
Azalea and Star Magnolia damaged by September hail-storm. Both plants had to be pruned back to the ground.



Chionanthus, Azalea, and Magnolia



Weigelia, Kolkwitzia, Syringa, Prunus, Philadelphus, and Magnolia



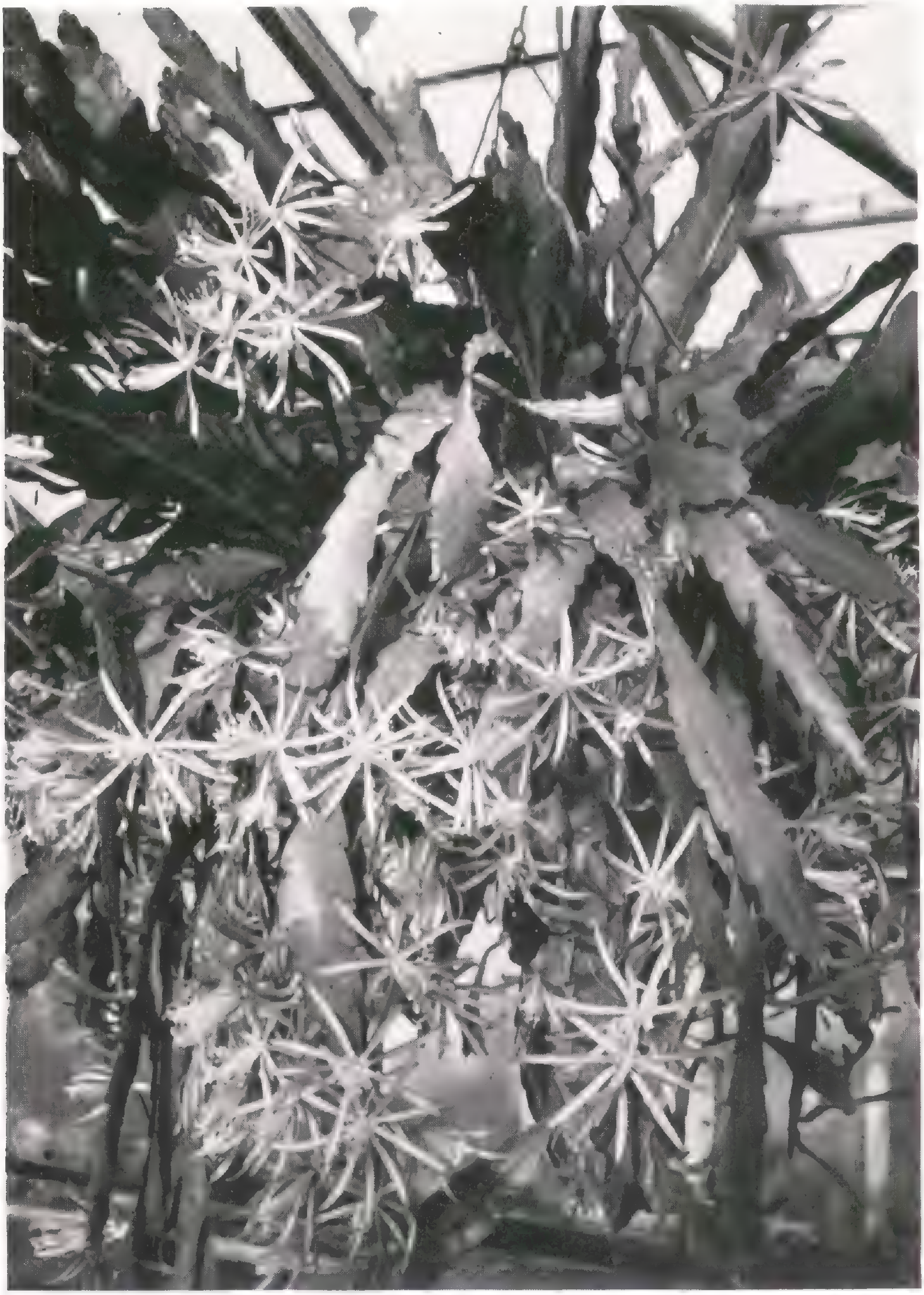
Above, Sumac branch damaged on the north side by hail; below, south side, undamaged.

TWIGS DAMAGED ON NORTH SIDE BY SEPTEMBER STORM that it will grow progressively worse during the season. The accompanying photographs, showing the damaged stems and branches on the north side of the plants contrasted with the undamaged portions on the south side, tell the tale more graphically than any description in words. The action of the hail was similar to a sandblast, cutting off or so bruising the bark that it exposed the wood; consequently almost universal "die back" is prevalent on practically all vegetation.

In addition to most of the large trees some of the most seriously injured plants were Azalea, Philadelphus, Cercis (redbud), Deutzia, Rhus (sumac), Viburnum, Buddleia, Kerria, Rhodotypos, Lonicera, Prunus, Ilex (holly), Magnolia, Chionanthus, Weigelia, Kolkwitzia, and Syringa.

Although we have had our share of cyclones and hail-storms nothing quite like this has ever struck the Garden, and we know of no similar case. Too small to do any direct damage, the fine hail driven by the terrific wind was sufficient to kill the living tissue wherever it struck. In only the rarest cases was the plant able to attempt to heal the broken place, a reaction which would normally occur almost inevitably. We await with some anxiety the final toll.

Natural gardens of Amsonia.—There are some Missouri wild-flowers that can only properly be seen with a boat, not that they grow in the water but because they develop best on sand and gravel bars and the display will be good at one place one year and another the next. By going down the river in a boat one can see them on one gravel bar after another and come upon the place where they are best in that particular year. Outstanding among these plants is the Ozark Amsonia, *Amsonia illustris.* It is found quite commonly in Missouri in rocky creek beds and on gravel bars along such rivers as the Meramec, the Bourboise, and the Big. Its strong roots anchor in the basic gravel of these bars, and in those long curving arcs which become floodways for the river at high water they have little competition and sometimes grow in garden-like perfection for a hundred feet or so. In late May and early June they are one of the most glorious wild flower spectacles in the New World, yet few Missourians have ever seen them, and almost nothing has been written about them. The Amsonia plants grow in thrifty clumps with graceful shiny leaves almost like a willow. The flowers rise well above the leaves in large open panicles of soft gray blue, each flower a perfect blue star. The shade of blue varies slightly from plant to plant and a great curving arc of hundreds of plants all in flower is a sight long to be remembered.—E. A.



Pseudorhipsalis macrantha grown in a hanging basket

A NOVEL CACTUS FOR THE HANGING BASKET

LADISLAUS CUTAK

The progressive gardener is always looking for new plants to try out, and if he happens to be a "cactophile" he is on the lookout for new succulents, particularly those that are easy of growth and are fitting subjects for the sun-porch, greenhouse, or window. At this time I'd like to bring to the attention of the cactus enthusiast a fairly new plant, *Pseudorhipsalis macrantha,* which is destined to become a great favorite. It will be found to be appropriate for hanging baskets, as the accompanying illustration shows. At present it is still a rare plant, but a few of the California nurserymen have it in stock.

Pseudorhipsalis macrantha is one of the many discoveries credited to Thomas MacDougall, a New York nurseryman who spends his winters in Mexico. He first collected the species north of Niltepec, near La Gloria, in the state of Oaxaca, during the winter of 1939-1940. Cuttings were brought back to New York and grown to maturity, at which time it was found to be a new species. In 1944 Mr. MacDougall presented the Garden with a cutting. It was promptly rooted and when new shoots developed they were in turn cut off and rooted to form additional plants. One of the stems condescended to bloom in 1946. At present, our specimens are being grown in 5-inch flower pots from which shortly they will be shifted to a hanging basket. In the wild state, Pseudorhipsalis is found upon trees growing in company with other epiphytes. The accompanying illustration gives a hint as to its lush growth. Grown in a hanging basket, lined with sphagnum moss, and filled with a porous compost of sand, rotted cow manure, humus, and loam, with liberal watering during the growing season, it makes a magnificent plant, particularly when studded with slender, golden, star-like blossoms.

Herewith is a detailed description of *Pseudorhipsalis macrantha*—a plant deserving a place in every sunlit porch or greenhouse.

An epiphytic plant with phylloid (leaf-like) stems and branches. Joints are slender, not excessively succulent in the strict sense of the word, but thin and flat, tapering into a petiole-like base. The stems may be anywhere from 5 inches to 3 feet long. Margins are crenate with small areoles that are minutely gray-felted. Flowers range from 2¼ to 2¾ inches (6–7 cm.) long, equally as broad when fully expanded. They are very fragrant, usually solitary from the lateral areoles, although Mr. MacDougall states that often 5 or 6 buds will develop from one areole on some of the oldest joints. Flower tube is slender and naked, about 1 inch long (2.5 cm.), or with 1 or 2 minute scales in the lower portion, Chrysolite Green* (pale green),

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* Technical color terms are those of Ridgway, Color Standards and Color Nomenclature.

later much lighter or flushed Pale Yellow-Orange. Perianth lobes (sepals and petals) are linear, 1¼–1½ inches (33–39 mm.) long, about ⅛ inch (3–4 mm.) wide, cucullate (hooded) at the apex. Nine perianth lobes appeared in each of the flowers on our plant, but as many as 13 have been reported in the New York plant. The 3 outer perianth segments were Yellow Ocher (light brown-orange) with rose-purple base, turning deeper in color (Orange Cinnamon) on the third day. All others were Wax Yellow throughout or whitish at base. Stamens appeared to be numerous, somewhat decurved, the filaments white, ¾–1¼ inches (2–3 cm.) long, while the anthers and pollen were Ivory Yellow to creamish. Style and stigma lobes white, equalling or slightly exceeding the stamens. Stigmas spreading, strongly recurved, strongly papillose (minutely teat-like), 4 or 5 in number. Ovary is small, about ¼ inch (5–6 mm.) long, light Mineral Green in color, with 5 or 6 minute brownish-purple scales.

The Flower With Two Smells.—

Allium hyacinthoides is a flower with two characteristic smells which are very different from each other. It is native to the Great Plains where it often blossoms abundantly in late spring, making great patches of pink in sandy places. The flowers not only look like little hyacinths, they smell like them too and though they are only a few inches high the scent is so strong that you can smell it just walking by. If you pick a bunch of them they have a curious mingling of two quite different odors. The flowers are just as fragrant as ever after they are picked, but Alliums are onions, even when they are Hyacinth onions, and the cut stems reek strongly of garlic. It is a curious sensation to sniff alternately at the two ends of a little specimen, the one so sweet and the other so garlicky.

If one can obtain bulbs from some dealer in native plants, *Allium hyacinthoides* is a beautiful and interesting plant to grow but a little wayward in its likes and dislikes. Though I have mixed sand in the soil it has persistently got weaker and weaker in the spot where I originally planted it, only to seed itself in considerable quantity between the cracks of a brick walk nearby. E. A.

The Elephant's-foot, *Elephantopus carolinianus*, is a strange little weed with pinky-blue flowers in discouraged little heads. To one who knows a little about the family to which it belongs, the Compositae, it is interesting because it suggests relationships between that family and others among the flowering plants.

NOTES

Mr. Lee Wayne Lenz, who holds a fellowship at the Garden from the Pioneer Hi-Bred Corn Co., Des Moines, Iowa, has received a scholarship from the Rockefeller Foundation to work for six months on the Foundation's Corn Breeding project in Mexico.

At the Washington University commencement, on June 12, advanced degrees were conferred upon four students in the Shaw School of Botany:—Russell J. Seibert and Gerald B. Ownbey, Doctor of Philosophy in Botany; Robert Baxter and John Finan, Master of Science.

Among recent visitors to the Garden were: Dr. George F. Carter, Assistant Professor of Geography, Johns Hopkins University, Baltimore; Dr. A. T. Erwin, Professor of Horticulture, Iowa State College, Ames; Dr. Emil Heitz, Geneticist, Universität Basel, Basel, Switzerland; Mr. W. C. Jennings, Manager Hakulau Plantation, Hakulau, Hawaii; Dr. George Neville Jones, Assistant Professor of Botany, University of Illinois, Urbana; Mr. L. D. Pryor, of the National Park Service, Canberra, Australia; Mr. Frank J. Lind, Orchid Grower, of Westwood, N. J.; Mr. Robert Schreiner, of Schreiner's Iris Gardens, Salem, Oregon; Mrs. F. Bucholtz, wife of the late Dr. F. W. Bucholtz, who was a distinguished botanist in Russia before the Russian Revolution.

Narcissus gracilis.—

Several years ago the Garden purchased a small shipment of Narcissus bulbs under the name of "Yellow Biflorus," from a dealer who frankly admitted that he did not know their varietal name but recommended them for naturalizing. When they flowered they proved to be the old variety "Gracilis," which is seldom seen or heard of in this country but which has been known in European gardens for many years. Even there it is somewhat of a rarity.

Narcissus gracilis is indeed an excellent variety for naturalizing and so late-flowering that it prolongs our Narcissus season at Gray Summit by several days. It is an old garden plant which is thought to be a natural hybrid of the true Jonquil *(Narcissus Jonquilla* var. *simplex)*. The smallish flowers, about the size of a five-cent piece, are borne in groups of two or three, on tall slender stems. The flowers are flat with a small cup in the center and are a soft pale yellow and deliciously fragrant. They have a heavy texture and stand up well under the hot drying winds which often blow from the southwest towards the close of the daffodil season. They are increasing slowly in the plot where they have been planted at Gray Summit and promise to make an interesting addition to our collection of Narcissi.

E. A.

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

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Missouri Botanical Garden Bulletin

Vol. XXXV SEPTEMBER, 1947 No. 7

EPIPHYTES—PLANTS OF THE TREE TOPS

HENRY N. ANDREWS AND PAUL H. ALLEN

In the varied, almost endless world of living things there is an equally far-reaching significance to the rather well-worn bit of nonsense:

> "So naturalists observe a flea
> Hath smaller fleas that on him prey
> And these have smaller still to bite 'em
> And so proceed *ad infinitum.*"

The necessity of a working agreement between the many clans of mankind becomes more evident every day. Man, we think, is the most advanced of all living things, yet in far too many instances his attempts to fit into the existing life patterns around him have been notably unsuccessful. We could learn much from the intricacies of natural associations in the plant kingdom. While we are just beginning to learn that "Man cannot live alone," countless thousands of plant species learned long ago that their own desires and needs must be carefully woven into those of their associates—and they have accomplished this without losing their own individuality.

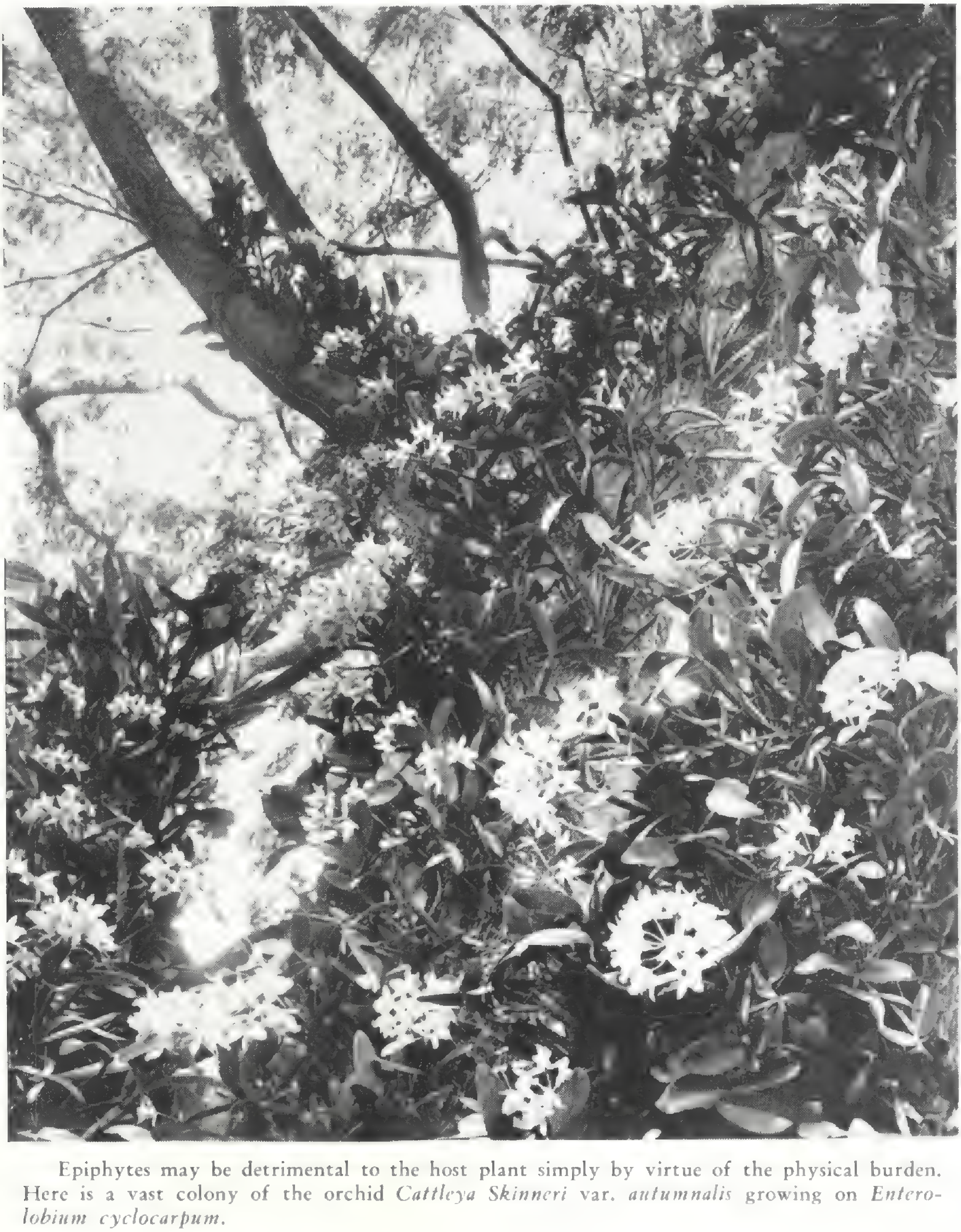
There are many instances where plants and animals live very closely associated, and these relationships vary in kind and degree. When one organism such as the mistletoe or the dodder actually penetrates the host plant (plant on which it is growing) and draws living juices from it we call that organism a *parasite.* Similarly, certain bacteria, worms, insects, etc. may be parasitic on the body of man and other of his fellow creatures. However, it will be recalled that the mistletoe is green, whether it be the kind that is commonly found on oak trees in the South or the common one of the lodgepole pine in the West. It is, therefore, only a partial parasite, manufacturing some of its own food and obtaining the rest directly from its host.

Some plants extract nourishment from their previously expired fellows. Others, such as the fungi, the Indian Pipe, the Coral Root orchid, etc., obtain their food from decaying logs and the partially disintegrated litter of the forest floor. These, we refer to as *saprophytes.*

A third group, including many lichens, mosses, and liverworts, as well as a host of tropical plants such as the orchids and bromeliads, exist as *epiphytes.* These "live upon" other plants only from the standpoint of occupying space and are neither parasites nor saprophytes. The first requirement of an epiphyte is freedom from extended periods of cold, hence the tropics are especially rich in these plants, but we may first consider one a little closer to home.

Certainly the most resplendent example of an epiphyte in the United States is the Spanish Moss of the Gulf Coast states. The long gray-green streamers festooning the trees of the streams and bayous are as typical of the "Deep South" as the sagebrush is of the West. And there are few plants that ask as little in return for the graceful beauty that they bring to the world. In spite of its popular name it is not a moss but a member of the Bromeliad, or Pineapple family, with small inconspicuous flowers. Since this plant more or less typifies the social life of the epiphytes it will serve adequately to outline this distinctive mode of existence. Fragments of the plants may be torn loose from one tree and blown to another where they catch in a branch and continue to grow. This may continue until the tree is densely shrouded in the streaming "moss." Those who are not familiar with the life processes of plants in general may wonder how they survive without contact with the soil, for the only way in which the mineral requirements of the plant are satisfied is from the traces of dust that accumulate about the points of attachment of the plant. No roots are present or needed, absorption of the nutrient elements taking place, as in most bromeliads, directly through the tender basal leaf tissue.

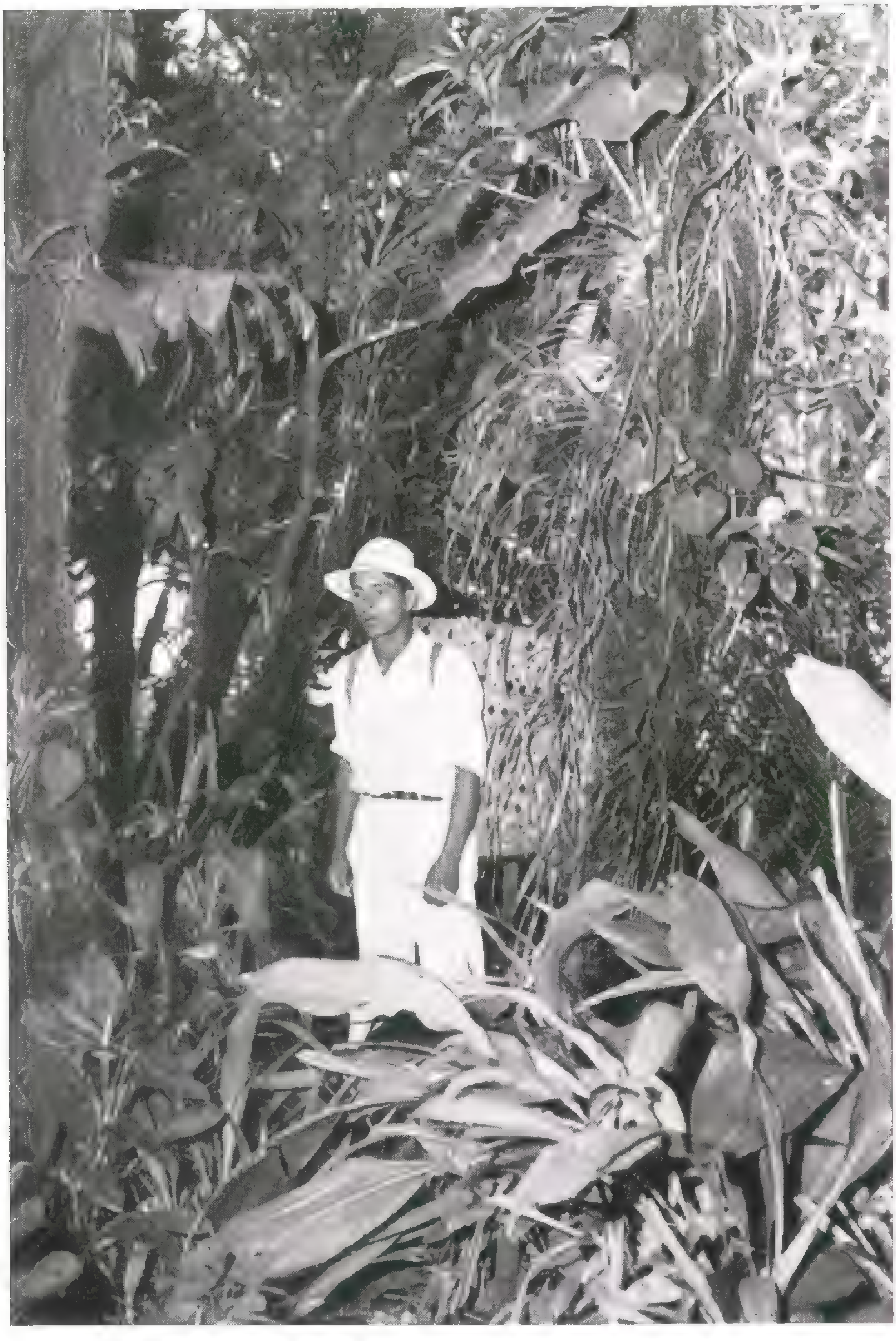
The actual dry weight of plants in general consists to a surprisingly small degree of minerals extracted from the soil, most of it being the three elements, carbon, hydrogen, and oxygen, which are taken from the air and water. Spanish Moss, although perhaps on the exceptional side, illustrates how relatively little in the way of minerals a plant requires for continued growth. It is not uncommon to find this plant thriving on telephone wires where the amount of accumulated mineral matter is indeed very slight. Spanish Moss cannot be classed as a parasite because it does not extract food from its host, but, being green, manufactures its own food. However, it may develop to such an extent that it prevents the development of sufficient



Epiphytes may be detrimental to the host plant simply by virtue of the physical burden. Here is a vast colony of the orchid *Cattleya Skinneri* var. *autumnalis* growing on *Enterolobium cyclocarpum.*

leaf surface by the host and thus it indirectly inhibits or destroys the latter. Similarly, epiphytes in the tropics may grow in such tremendous numbers on their host as to bring it crashing to the earth by virtue of their weight.

Visitors to the Garden during the past few years have noticed that the trunks of the trees in the Palm House are now generously bedecked with epiphytic plants known as bromeliads, larger and showier members of the



Typical forest vegetation of the crest of Cerro Pavita, El Valle de Anton, Panama, altitude 3500 feet.

Dense profusion of bromeliads and other epiphytes in the hills north of El Valle de Anton, Panama, altitude 3500 feet.

family to which the Spanish Moss belongs. And to those who have driven through southern Florida, particularly along the Tamiami Trail between Miami and Fort Myers, the millions of these plants perched up in the cypress trees present a memorable sight strikingly expressive of the linkage in this area between the tropics to the south and the cooler latitudes to the north. The horticultural possibilities of these bromeliads, some of which have beautifully variegated leaves and brilliant crimson and blue flowers, are just being realized, and it is very likely that they will become frequent, if not common, house plants with continued selection and improvement of the most suitable varieties.*

Even seasoned travelers who really should know better often mistake the bromeliads for orchids as it seems to have become traditional that all plants that live up in the trees as epiphytes in the tropics or sub-tropics must be orchids. However, the botanists are not splitting hairs in distinguishing the two groups, for they are as different as a gopher and an elephant. The characteristically thin, rather rigid leaves arranged in whorls and overlapping at the base, and the absence of fleshy stems, bulbs, or leaves set the bromeliads decidedly apart from the orchids. Moreover, in Florida the orchids are not as abundant as the bromeliads and are generally smaller.

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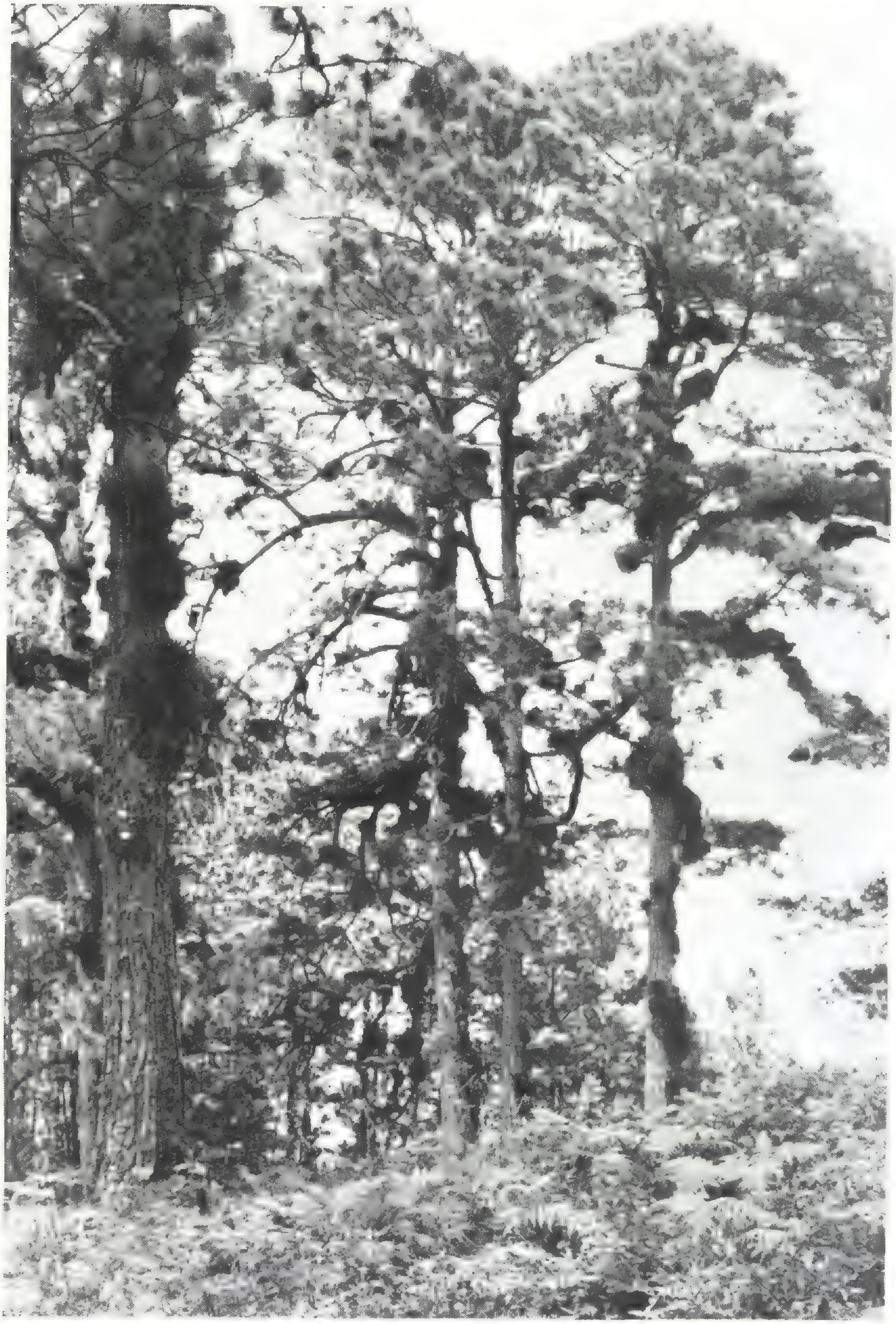
* See "Bromeliads are fascinating plants". MISSOURI BOTANICAL GARDEN BULLETIN, September, 1945.

Most epiphytes, be they orchids, other herbaceous plants, or shrubs, are decided xerophytes, that is, they have pronounced variations from normal structures to conserve moisture. As epiphytes, they must supplement their meager supply of nourishment and insure their propagation. Many and ingenious are the contrivances that have been evolved to meet these needs. Most bromeliads, for example, have their leaves loosely or tightly imbricated at the base so as to form a natural tank. Although the upper three quarters of the leaf has a nearly impervious surface, resistant to the most extreme drought, the basal quarter is of tender absorbent tissue, through which nutriment and water are obtained. The roots of the larger kinds serve mostly as cables to hold the tanks in an upright position, contributing little or nothing to the sustenance of the plant. Epiphytic orchids have the leaves or stems swollen for water storage, and the thickened roots of many contain symbiotic nitrogen-fixing bacteria which contribute this necessary element from the orchid to the air. Others also develop masses of roots which point hundreds of rootlets upward, to catch minute accumulations of nutritive material. Some African and Australian ferns have specialized basal fronds which act as funnels for the accumulation of decaying leaves. Several of the tropical American epiphytic relatives of the common huckleberry have developed swollen tuberous roots, as well as leathery leaves, to conserve moisture. A last, but extremely important, requirement for epiphytes is facility for propagation. The seeds must be light and tiny enough so that they can be sown by the wind through the tree tops and find crevices in the damp bark to begin life anew, or they must be attractive to birds, or provided with a sticky coating for attachment to bark until germination takes place. Both orchids and bromeliads, as the apex of the epiphytic line of development, have perfected tiny seeds, ideally adapted to such a mode of existence. Orchid seeds are so tiny that nearly a million may be contained in a single pod, and the seeds of bromeliads, while larger, are provided with parachutes which carry them through the forest top.

In the tropics a great number of plant families are represented among the epiphytes having little in common except the previously outlined prerequisites for life in high, often sun-drenched areas of the forest top, on low scrubby trees on the margins of grasslands, or on bare rocks, all subject to pronounced fluctuations in moisture supply. However, since all are closely related to common terrestrial forms it is of considerable interest to consider how they acquired their present habit.

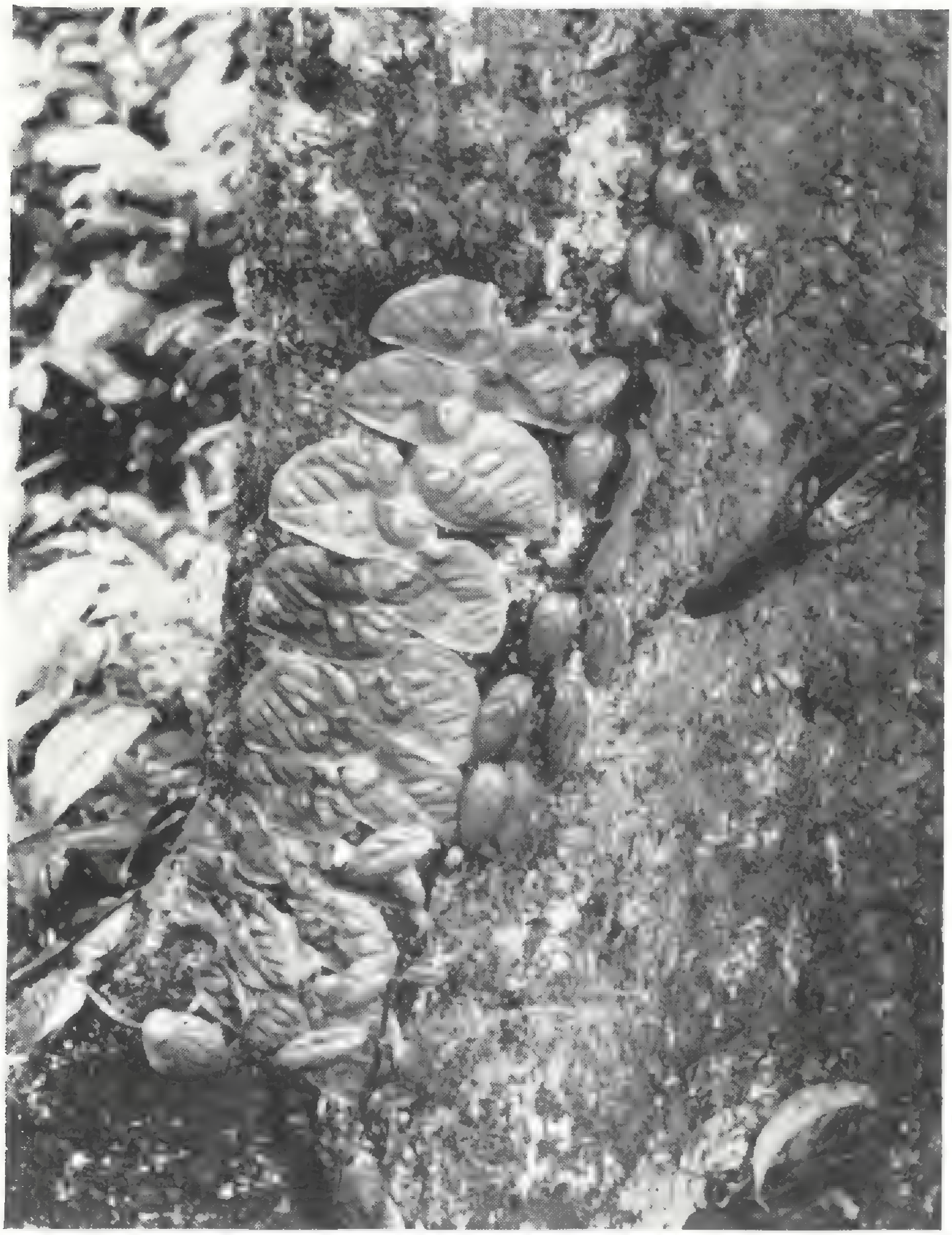
Epiphytic shrubs such as those of the genus Marcgravia (a tropical



Tillandsias, close relatives of the Spanish Moss, growing on pines in the highlands of Siguatepeque, Honduras—5000 feet.

Pitcher-plant) began as root climbers, with the seeds germinating in the ground and the almost ivy-like seedlings (which are of a very different appearance from the adult plants) climbing to the forest top where they develop adult woody branches, foliage, and flowers. Some species of Hydrangea and many Aroids (Jack-in-the-pulpit family) have been able to free themselves from this pilgrimage to the ground each generation, but are still mostly dependent for a start on accumulations of humus in tree forks or other cavities. Many pseudo-bulbless, shade-loving orchids, as well as many Aroids, have never gone the whole way, but have remained on the shaded lower tree trunks where they suffer less from lack of moisture. Some typically epiphytic shrubs live as entirely independent aerial organisms while others, as noted above, have a link with the ground through the juvenile stage; and still others are giant woody shrubs alternately climbing or epiphytic, depending upon the situation. Still others begin life in the tree tops but in time establish contact with the ground by long interlacing roots which often strangle the host. Certain wild species of Ficus (figs), Clusias known in the American tropics as "Copey" or "Sambogum," and Topobeas fall in this class and may be seen perched in the tops of forest trees, their roots making a living straight-jacket about the trunk or they may be found on occasion atop a granite boulder existing without benefit of nourishment except what can be acquired from bare rock, water, and air.

Most primitive orchids and members of the heath family are terrestrial and seem to have had an epiphytic existence forced on them by changing circumstances. The story of the geologic history of the interior of northern South America may serve as an example. An extensive highland plateau once covered much of this area but has been almost entirely removed by erosion over vast periods of time, the region now being largely reduced to a peneplain with isolated remnants of sandstone mesas. These today form a vast archipelago of floristic islands, their bases lapped by the sea of lowland forest. Primitive terrestrial orchids abound on many of these mesa tops wherever there is any soil left while adjacent blocks of bare stone harbor thriving colonies of orchids differing from their terrestrial neighbors in the possession of well-developed pseudo-bulbs or succulent or deciduous leaves. With increasing radiation and sharper run-off of available moisture it seems quite possible that these more specialized forms developed in place from the more primitive types. Long isolation of small residual groups of orchids able to withstand such severe conditions, and being in turn molded and modified by such necessity, might well produce significant racial developments. Once equipped with means of protecting themselves against drought it would seem to be an easy progression to adjacent rough-barked



Young plants of Philodendron (broad-leaved) and Columnea starting the long climb to epiphytic status. Mature plants bear little resemblance to this stage.

trees and on to the tops of the lowland forest giants. From such small beginnings in areas of stress a rich divergent development might be expected under more favorable circumstances such as are found in the Brazilian coastal range or the mountains of Antioquia in Colombia.

Among the most curious of all epiphytes are the large-flowered species of Utricularia (the Bladderworts) found in wet moss at high elevations from Brazil to Costa Rica.* These have probably been derived from terrestrial forms which in turn have purely aquatic ancestors. Typical aquatic Utricularias have been seen on the elevated sandstone Yapobodá in the

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* Aquatic bladderworts, typical of the group, are common in ponds throughout the United States and are often used in pools and fish-bowls.

Vaupes (Colombia) growing in water not a half inch deep along sandy margins of seepages flowing over bare rock, the leaves much reduced, but with a super-abundance of traps for catching minute animals. Adjacent moist sand had several terrestrial species some of which resemble species found as far north as Panama. As the soil was swept away by erosion during ages of time, it would seem possible that these terrestrial forms may again have been developed here on the sandy margins of ponds, and as the situation became progressively drier and the radiation more intense, they retained the battery of traps, but with the leaves reduced to slender, strap-shaped structures. These terrestrial species are common in damp places and may be found in wet moss high on rock faces of mountain peaks. Any plant capable of sustaining itself in the latter situation would indiscriminately grow on adjacent mossy wet tree branches, the traps distributed through the moist cushion catching microscopic creatures for sustenance.

Thus it is evident that more than a few words are needed to define just what an epiphyte is. Clearly enough, they all live upon other plants or upon rocks. Some have done so for countless generations while others, seemingly not so long evolved from their terrestrial ancestors, must return in their early stages to the soil for a start. And why, it may be asked, do these plants want to climb up in the tree tops anyway? The answer seems fairly simple in that tropical forests are often so dense that little light reaches the ground and to obtain enough for survival they must exist on the "roof" or not exist at all. However, there is much that we do not know about these complicated plant associations that we find today. We have pointed out a few of the probable ways in which the epiphytic habit came into being and it is of much interest as a remarkably successful social adaptation in which the epiphytes, the invaders themselves, have wrought but little harm to the host plants.

The common name of Evonymus atropurpurea.—Common names were never distributed fairly among the plants. Some charming shrubs, such as Fothergilla, remain forever unknown to the general public largely because no good common name has ever become attached to them, while others, such as *Evonymus atropurpurea,* have several good ones. The greatest distinction of this latter shrub lies in its fruits, which are like those of its viney relative, the Bittersweet, except that they are blood-red instead of orange. Its commonest common name in Missouri is "Burning Bush," though the Indian term "Wahoo" is often heard. Down in the Great Smokies the common name there, though more imaginitive, is descriptive of the way the blood-red berries hang down from the opening seed-pods. To be sure, it is a little long for an every-day name, but it is worth remembering, "Hearts-bursting-with love."

COLCHICINE AND PLANT BREEDING

GUSTAV A. L. MEHLQUIST

Since the introduction of colchicine to the American public in 1937 by Drs. Blakeslee and Avery many extravagant claims have been made for this drug. Its use has made possible the production of plants greatly increased in size and bearing giant flowers, the latter having received much of the publicity. Increased seed fertility has also been claimed, although in most instances the reverse has been true. Judging from correspondence received at the Garden it might be well to examine these conflicting claims and ascertain what can be expected from colchicine treatments and how these effects come about.

In the first place, whatever colchicine does, it does through its effect on chromosomal behavior. The chromosomes, which have received so much public attention in recent years, are minute protein bodies on which are borne the hereditary units known as genes. Because of this organization the behavior of the chromosomes in the formation of the sex cells is the determining factor in the distribution of the genes which are so important in the continuity of life.

Nearly all plants and animals have a constant number of chromosomes in each cell. In normal fertile individuals this number is even as they occur in pairs, for although there are usually several different kinds of chromosomes there are two of each. Having a pair of each type of chromosome is not always necessary for the survival of the individual but it is of great importance for its fertility. *Like begets like* is an old saying that explains the relative likeness between parents and offspring. The mechanism whereby this comes about is very interesting in itself, and, because it is through this mechanism that colchicine produces its effect on plants and animals, let us summarize the pertinent facts.

1. The genes (hereditary units) determine the similarity (and also the differences) from generation to generation.

2. These genes are attached to the chromosomes.

3. The chromosomes are usually constant in number from generation to generation, the exact number being dependent on the species in question (man has 48, the vinegar fly 8, the common carnation, *Dianthus caryophyllus,* 30, the cheddar pink, *Dianthus caesius,* 60, and the cottage pink, *Dianthus plumarius,* 90).

4. In normal fertile individuals the chromosomes occur in pairs.

5. In the formation of sex cells the number of chromosomes is halved so that each sex cell (egg or sperm) contains one half of the number characteristic for the species.

6. In fertilization, resulting in a new individual, the full chromosome number is restored by union of two sex cells.

In general, if the chromosome number of an individual or a species is doubled the result is some degree of gigantism—a plant with larger and thicker leaves, heavier stem, and larger flowers. It is because of this increase in size, which may be brought about by colchicine, that its use has appealed to so many "would-be" plant breeders. We live in an age where size is greatly esteemed.

Chromosome doubling occurs spontaneously in nature and can be brought about in culture by many different means but the surest is by the use of colchicine. There are various methods of using this powerful drug but wherever practicable treatment of seeds is the simplest and most economical. Seeds of different species vary as to the strength of colchicine solution required, and unless specific information is available one usually divides the seeds into many small lots and then tries solutions of varying strength on the different groups. Another simple and effective method is to use only one strength solution but to vary the length of treatment. With seeds that can be germinated easily between moistened blotters or paper towels, chromosome doubling can be more readily effected by applying the colchicine just as the root is emerging through the seed coat. By this procedure the concentration of the colchicine or length of treatment should be greatly reduced.

Seeds of some plants germinate so poorly after an application of colchicine that it is better to defer the treatment until the first true leaves of the seedling appear. Plants that transplant readily, such as snapdragons, marigolds, and other annuals, can be lifted from the seed flats and stood on their heads in the solution, the roots being wrapped with moist paper to prevent drying. With plants not so readily transplanted it is safer to place a drop of the solution, by means of a pipette, squarely on top of the seedling without disturbing it otherwise. In order to keep the drop from falling off, a small amount of absorbent cotton may be placed on the tip of the seedling before treatment. In plants where doubling is difficult to bring about one drop each day on three consecutive days may be tried. Usually this is as much as even tough seedlings will stand without being killed.

Hybrids that do not come true from seed or plants whose seed is scarce or very expensive should be reproduced vegetatively until several are available. Then the topmost leaves on vigorous shoots should be cut off so as to almost expose the young tissue around the growing point, a small amount of absorbent cotton or gauze placed on the tip, and the colchicine solution applied by means of a pipette. One or two drops a day for one to three days is usually sufficient to bring about results. Frequently the stem tips are killed back a little distance but as a rule this does not nullify the treatment as the young side shoots immediately below the killed tip may show the desired effect. If the plants are treated outdoors the tips should be enclosed in glass tubes or jars to prevent too rapid drying of the colchicine.

The latest stage in the life of the plant when a treatment can be expected to be effective is during the period of sex-cell formation. This must be timed to coincide with the unique series of two divisions during which the chromosome number is reduced to one half. These divisions usually take place when the buds are quite small, and it is difficult even for experienced people to determine the exact stage.

Other vegetative parts of plants, such as tubers, corms, bulbs, and scales, can also be treated in order to induce chromosome doubling. However, special schedules are required, and those interested should look them up in the various references listed.

It should be borne in mind that colchicine is extremely poisonous and should be properly labelled and kept out of reach of children or other persons not familiar with the dangers. The simplest method of preparation is to dissolve the colchicine in a small amount of alcohol (your favorite brand will do) and then add water until a 1 per cent solution is obtained. This should be kept in a cool dark place and then diluted according to the schedules shown below.

Seed treatment.—

Soak dry seeds in $^2/_{10}$ of 1 per cent solution for 1 to 24 hours. Pour off the solution and rinse the seeds in water. Plant as usual. The same strength may be used on germinated seeds but the length of treatment should be much less, 5 to 30 minutes usually being sufficient.

Seedling treatment.—

Use drops of $^2/_{10}$ of 1 per cent solution as described above. When the seedlings are removed from the soil and inverted in the solution use only $^1/_{10}$ per cent for from 1 to 10 minutes. Do not expose the treated seedlings to strong light for the first 2 or 3 days after treatment.

Stem Treatment.—

Try $^2/_{10}$–$^4/_{10}$ per cent solution in drops through cotton or gauze as described above. If the whole plant can be inverted so that one or more tips are in the solution the treatment usually need not exceed 10 to 30 minutes.

Bud treatment.—

Use $^2/_{10}$–$^4/_{10}$ per cent solution through cotton or gauze or invert plant for 10 to 30 minutes during the mid-morning hours (the reduction divisions are most likely to take place then).

Roots, tubers, bulbs, scales, and bulbils.—

Soak in $^2/_{10}$–$^4/_{10}$ per cent solution for 1 to 48 hours and plant as usual.

Discussion.—

With seed treatments, and sometimes with stem treatments, it is often desirable to use a wetting agent to insure good contact between the tissues and the solution. A small amount of *Vatsol*, *Santomerse*, or similar material will greatly increase this wetting power.

As already has been pointed out, the fertility of plants is dependent on the chromosomes occurring in pairs. During sex-cell formation the members of each pair (known as homologous chromosomes) go to separate daughter cells during the first division, thus reducing the number in each cell to one-half. In the second division all the chromosomes are divided lengthwise so that the new daughter cells contain one-half of each chromosome but the number remains the same. This second type of division is the prevailing one throughout the plant except when sex cells are formed in the young buds. Thus all the tissues and organs of the plant are built up from cells that have arisen from division of existing ones, the first cell being the one resulting from the union of an egg cell with a male gamete. As every division except the reduction-division involves equal lengthwise division of every chromosome and their orderly separation into daughter cells it follows that all the cells except sex cells have the same chromosome number. Vegetative propagation of the plant through cuttings, divisions, scales, or bulbils does not change the number, neither does reproduction from seed alter it unless something has interferred with the orderly pairing and separation of the homologous chromosomes in the reduction division. Now colchicine does just that. In a normal cell the homologous chromosomes (whole chromosomes in the reduction division and half chromosomes in all other divisions) are pushed apart by some force. Colchicine upsets this force,—all of the chromosomes remain in one cell, and in the following divisions the doubled number is retained. As every cell that arises from this one changed cell will normally have the increased number of chromosomes colchicine treatment may give rise to branches or, when seeds are treated, to whole new plants with the double number. The changed branches may be reproduced vegetatively by cuttings, or the seeds from such branches may be harvested separately to give individuals with the changed number prevailing throughout. These plants are known as *tetraploids* ("*tetra*" meaning four, referring to the four sets of each type of chromosome) in contrast to (normal) plants with only two sets which are known as *diploids.**

Tetraploid plants of this type are known as *autotetraploids* because the chromosome number has been doubled within the plant or species. They are usually considerably less fertile than the corresponding diploids, because four of each chromosome type causes confusion during the reduction division. Whereas two chromosomes of a kind can give rise to only one combination, namely, one pair, four can enter into three different combinations, namely: two pairs, a trio and one single, or a quartet involving all four. This "upsets the genetic balance" so that sex cells with *more or less* than the half number of chromosomes result, and they are usually less variable than those with just one-half of the original number. In some plants this difference in viability is quite pronounced.

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* See: Anderson, Edgar. What is a tetraploid? in Mo. Bot. Gard. Bull. 34:43–48. 1946.

If two plants of different species are crossed, the resultant hybrid may be sterile because the chromosomes brought in from the two parents are so different that they cannot pair. Now, if the chromosome number of such a hybrid can be doubled there will again be two chromosomes of each kind, normal pairing will take place, and the result is often high fertility. A hybrid such as this is known as an *allotetraploid*.

Autotetraploid plants generally have larger and thicker leaves, heavier and taller stems, larger flowers of heavier texture, and pollen grains of about twice the usual volume. Seed production is usually lower than in the corresponding diploid plants but the seeds that are produced are generally larger.

Allotetraploid plants may have these features but are often indistinguishable from the sterile hybrids from which they arose, except for increased fertility. This type of hybrid, moreover, often breeds nearly true—except for minor features. There is good evidence that many species in nature with higher chromosome numbers are allotetraploids.

If a tetraploid species hybridizes with a diploid the resultant hybrids are nearly always triploids (three sets of chromosomes). Such hybrids are usually sterile but may become doubled spontaneously, or artificially through colchicine, giving rise to fertile hybrids with six sets of chromosomes (allohexaploids). Tetraploids and hexaploids are common among ornamentals.

Frequently artificial hybridization between a diploid and a tetraploid is easier if the diploid is first doubled by means of colchicine.

Thus colchicine treatments are useful for three reasons:

1. Production of autotetraploids for their own value.

2. Production of autotetraploids for use in hybridizing with species of plants that are already tetraploid.

3. Production of fertile allotetraploid or allohexaploid hybrids from sterile diploid and triploid interspecific hybrids respectively.

To determine definitely whether or not chromosome doubling has occurred, expensive microscopes are required. However, an increase in the size of the pollen grains is usually a dependable indication that doubling has occurred, and that may be seen through an inexpensive microscope magnifying not more than 75–100 times.

References.—

Blakeslee, A. F., and A. G. Avery. Methods of inducing doubling of chromosomes in plants by treatment with colchicine. Journal of Heredity. vol. 28, pp. 393–411. 1937.

Dermen, Haig. Colchicine polyploidy and technique. The Botanical Review, vol. 6, pp. 599–635. 1940.

Emsweller, S. L., and Philip Brierley. Colchicine-induced tetraploidy in Lilium. Journal of Heredity. vol. 31, pp. 223–230. 1940.

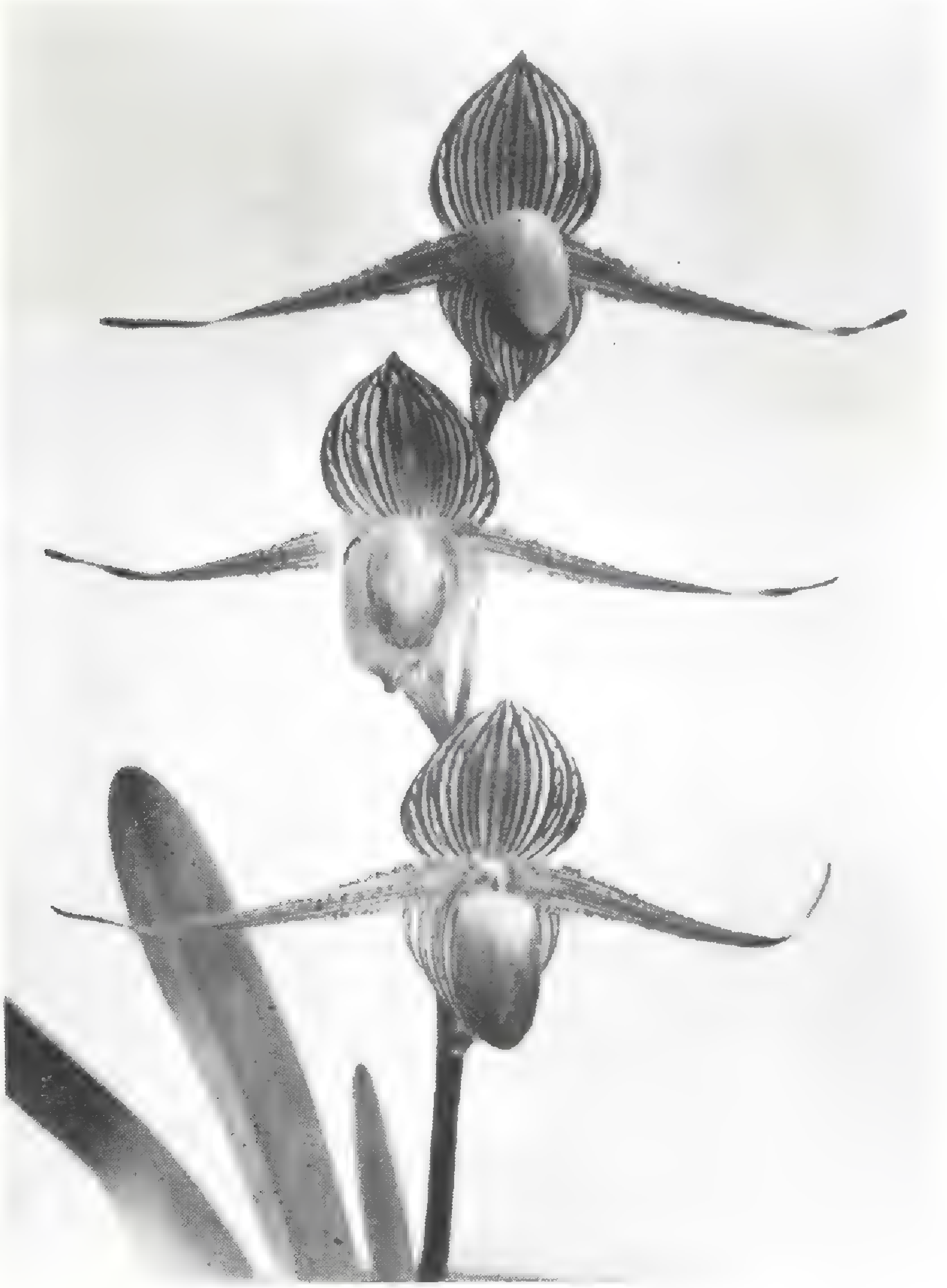
Mehlquist, Gustav A. L., et al. Colchicine-induced tetraploidy in *Delphinium cardinale.* Journal of Heredity, vol. 34, pp. 187–192. 1943.

Missouri Gravel Bars. To appreciate the gravel bars of Missouri one needs to have been brought up in the North where most of the gravel is glacial and twenty kinds of rock may be found in every gravel pit. Gravel bars there will be made up of many kinds and shapes of rocks, from soft sandstones to hard granites. Over most of Missouri there is no such variety; a bar will be made up almost entirely of chert, the brown shiny flint which weathers out of certain of our limestones. After it has been worked over by the river it is pretty much all the same size, shape, and color, and to a northerner looks almost artificial in its uniformity. On our Ozark rivers, such as the Current or the Meramec, there are relatively few plants which can grow successfully on these wide, glaring expanses of dry gravel but these few develop to perfection in the absence of competition. A bar of several acres may have only two kinds of willow or may be made up entirely of little groves of sycamores. There are several old and well-established gravel bars on the Current River which are of this sort. The sycamores, mostly all of the same age, divide the gravel bar off into a series of connected open stretches where the sunshine lights up the brown cherty pebbles. The bar may be half a mile long yet have almost nothing on it but the clean bright stones and the graceful sycamores in scattered groups. In the fall when the sycamore leaves turn a tawny yellow color which almost matches the chert, these little natural park-like islands look incredibly artificial. Frequent floods have kept the pebbles washed clean; the inhospitable environment has prevented other plants from gaining a foothold; and the little sycamore trees (which all started life together in some previous spring when conditions were just right on this particular spot) have grown into living harmony with the long stretches of water-swept gravel.—E. A.

THE OLDEST AND RAREST LADY-SLIPPER IN THE GARDEN COLLECTION—PAPHIOPEDILUM ROTHSCHILDIANUM

GEORGE H. PRING

This Lady-slipper is a native of Borneo, from where it was introduced into cultivation by Sander & Sons, of England, in 1888. It was a distinct ornamental novelty and was described by Reichenbach (Gard. Chron. p. 457. 1888) as *Cypripedium Rothschildianum* in honor of Baron Ferdinand de Rothschild. The flowers are produced, three to six on a stalk, which is rather unusual for this genus. A peculiarity of the flower is its form, the lip having a definitely pointed toe and extending straight out from the center of the flower. Unlike other species of Paphiopedilum, in which the pollen masses are covered by the circular shield-shaped staminode, in this species the staminode is shaped like a crane's or pelican's neck and the pollen is exposed.



Paphiopedilum Rothschildianum

Our first specimen of this rare Lady-slipper was purchased from Cowan & Sons, Liverpool, England, and was received at the Garden on May 28, 1904. It was propagated by division, so we now have two plants in the collection. This species does not make annual growths, but after several years it will produce a young growth which will take several years to reach the flowering stage. Unlike the other Lady-slippers, it is shy in flowering, being the slowest of any Paphiopedilum to come into bloom. By a coincidence, this year both Garden specimens flowered on the same day, April 20, and both produced three individual flowers on the stalk, one above the other. The flowers were arranged as if wired by a florist to form a shoulder bouquet (see illustration) and they lasted a month before drooping.

Description.—Sepals ovate, acute at the tips, yellowish-green with about 16 prominent purplish-brown stripes. Petals 4 inches long, ⅝ inch wide at the base, gradually tapering towards the tips, purplish-brown spotted and striped with purple, frilled and purplish at the margin with an occasional long purple hair. Lip purplish-brown, somewhat mottled, extending out from the center of the flower, shaped like a lady's slipper with a definitely pointed toe. Staminodia beak-shaped, covered with very fine purplish hairs tipped with gray. Both stigma and pollen masses exposed, stigma pale green, pollen mass purplish. Flower stalk stout, purple, arising from robust glossy green leaves which are 1 foot long and 1 inch wide.

The last flower to bloom.—A delicate little orchid is the last of our native wild flowers in this part of Missouri, but few indeed are the Missourians who have seen the plant. In spite of frosts and cold weather it comes into flower in well-drained rocky places in late October and early November. It is one of those orchids with many flowers in a tight little spike which are known as Ladies' Tresses. The authorities say that its name is *Spiranthes cernua*, but this is certainly one case where they have not yet had time to give a Missouri plant the study it deserves. *Spiranthes cernua* of New England and New York State is a plant with a pure white flower which blooms in midsummer along cool pasture brooks and such places. Our Missouri plant has flowers of ivory-white; it grows only on rocky glades and cliff edges, and it blossoms late in the fall. When the genus has been more intensively studied this species will probably prove to be at least varietially distinct from its better-known eastern relative.

NOTES

Mr. Hal P. Brady, Plant Recorder at the Garden and a familiar figure at the Main Gate for many years, died suddenly on June 27.

Dr. Edgar Anderson, Geneticist to the Garden, presided at the summer meetings of the Botanical Society of America, held in Montreal and Gaspé Peninsula of Canada, August 20–29.

Among the summer visitors to the City Garden and Arboretum were: Mr. and Mrs. Edward T. Teas, of the Teas Nursery, Houston, Texas; Mr. and Mrs. A. J. Proebstle, of Brazoria, Texas, who collaborated with the Garden in raising the first white-flowered *Nymphaea gigantea* from seed; Mr. T. G. Bacher, of Swiss Floral Co., Portland, Oregon; Mr. William B. James, of the University of Delaware, Newark; and Mr. Robert J. Warne, of Honolulu, H. I.

Mr. Ladislaus Cutak, in charge of Succulents at the Garden, attended the convention of the Cactus and Succulent Society of America, held in Cincinnati, June 27–29. After the meetings the following members of the Society made a trip to St. Louis to view the Garden collection of desert plants: Mr. Sherman E. Beahm, of Pasadena, Calif.; Mr. and Mrs. Laval Goulet, of Amos, Quebec, Canada; Mr. William Taylor Marshall, Director Desert Botanical Garden, Papago Park, Phoenix, Ariz.; Mr. J. E. Bock, of Sharon, Pa.; Prof. Art. Blocher, of Amboy, Ill.; Mr. and Mrs. Don Lutz, of Decatur, Ind.

Dr. Russell J. Seibert and Dr. Gerald B. Ownbey, former graduate students at the Garden who received their doctor's degrees at the Washington University commencement in June, have accepted positions for the coming year. Dr. Seibert has been appointed Botanist, Rubber Plant Field Station, at Turrialba, Costa Rica, a project of the United States Department of Agriculture, Division of Rubber Plant Investigations, in cooperation with thirteen Latin American countries. Dr. Ownbey has received an appointment as Instructor in Botany at the University of Minnesota, Minneapolis.

The second number of Volume XXXIV of the ANNALS OF THE MISSOURI BOTANICAL GARDEN was issued in June, with contents as follows: The Effect of the Medium on Apparent Vitamin-synthesizing Deficiencies of Microorganisms; A Direct Relationship between Pantothenate Concentration and the Time Required to Induce the Production of Pantothenatesynthesizing Mutants in Yeasts, by Carl C. Lindegren and Caroline Raut; Mendelian Inheritance of Genes Affecting Vitamin-synthesizing Ability in Saccharomyces, Carl C. Lindegren and Gertrude Lindegren; American Origin of the Cultivated Cucurbits, Thomas W. Whitaker; Fossil Polypores from Idaho, Henry N. Andrews and Lee W. Lenz; John Henry Britts—Physician and Fossil Hunter, Henry N. Andrews; The Idaho Tempskyas and Associated Fossil Plants, Henry N. Andrews and Ellen M. Kern.

Visitors to the Garden library during the summer months include the following: Dr. Joseph Becquaert, Curator of Insects, Museum of Comparative Zoology, Harvard University, Cambridge, Mass.; Mr. W. I. Booth, fiber plant specialist, of St. Petersburg, Fla.; Dr. William L. Brown, Geneticist, Pioneer Hi-Bred Corn Co., Des Moines, Ia.; Miss Thelma Cox, of McKee Jungle Gardens, Vero Beach, Fla.; Mr. Sala Dasanandra, of the biology department, Chula University, Bangkok, Siam; Prof. P. S. Davies, Head department of biology, University of Louisville, Louisville, Ky.; Dr. Maurice Errera and Dr. J. P. Greenstein, of the National Cancer Institute, Bethesda, Md.; Dr. David C. Fairburn, of the McKee Jungle Gardens, Vero Beach, Fla.; Dr. H. M. Good, of the department of botany, University of Toronto, Canada; Dr. Charles B. Heiser, Assistant Professor of Botany, University of Indiana, Bloomington; Dr. W. F. McDonald, Professor of History, Ohio State University, Columbus; Mrs. Iva Newman, of San Mateo, Calif., member of the American Rose Society and Garden Editor *Peninsula Life;* Mrs. A. J. Proebstle, of Brazoria, Texas, Assistant Editor, *Orchid Lore;* Mr. and Mrs. F. P. Walther, iris enthusiasts, of Montclair, N. J.; Dr. T. G. Yuncker, Visiting Professor of Botany, University of Illinois, Urbana; Mr. E. J. Palmer, of Webb City, Mo., Collector and Research Assistant, Arnold Arboretum of Harvard University, Jamaica Plain, Mass.; Mr. Walter C. Scholl, orchid enthusiast, of Chicago, Ill.

THE MISSOURI BOTANICAL GARDEN

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

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Missouri Botanical Garden Bulletin

Vol. XXXV OCTOBER, 1947 No. 8

THE CASTOR BEAN—AN IMPORTANT CROP FOR THE FUTURE

A. P. BEILMANN

There was a time when castor oil had a limited value, which was mostly to frighten children requiring disciplinary action. However, during the recent war it became so important to the nation that its civilian use was curtailed as early as October, 1942.

Great quantities of the oil and its derivatives are now used for industrial as well as military purposes. It has always been one of the constituents of hydraulic brake fluid, used in jeeps, trucks, tanks, on airplane turrets and bomb-bay doors. The oil is soluble in alcohol; it will flow at low temperatures; and it does not gum or leak through gaskets as do other oils. It is also used in the recoil mechanism of all cannon and heavy rifles. It is part of the lubricating oil of airplane engines, and, through a devious process, powder bags and nylon parachutes have their beginning in an acid of castor oil. It plays a part in the petroleum industry in the production of high octane gas. It has practically superseded paint, varnish, and lacquer as a protective coating for war equipment. Coatings made from a castor-oil base are applied to everything from helmets to warships. This is not the whole story—research has produced a powerful insecticide from the leaves, and the gigantic varieties of the plant are a source of alpha cellulose.

Obviously, the crop was not grown in the United States on a large scale before the recent war, or the farmer would have increased production during the shortage, as he was able to do with most foodstuffs. The plant disappeared as a farm crop shortly after 1900 when plantings were increased in Brazil and India. The recent shortage of the oil was due to the shipping hazard and lack of shipping space from those countries. But at one time, about 1860, castor beans were grown in Oklahoma, Illinois, Missouri, and Kansas. Then the only pressing plant in the world was in St. Louis. When this was moved East the castor-bean plant merely became an ornamental, no longer a crop, in the Middle West.

In view of the fact that an effort to re-establish the crop is now being made, it might be well to review its history. In Bulletin No. 25 of the Oklahoma Agricultural Experiment Station, June, 1897, there is a "fertilizer analysis" of the plant. A year later a bulletin from the same Station proposed returning the pods, stems, and leaves to the soil to maintain fertility. In succeeding years a chemical analysis of the plant was made and a study of yield in relation to planting time was carried on. In 1902, Professor W. R. Shaw proposed seed selection as a means of improving the cil content. However, by 1907 the castor bean had all but disappeared from the literature. In fact, the *Yearbook of the United States Department of Agriculture* for 1903 and 1904 gives no production figures and only a vague outline of the industry, so we may assume that the crop was all but unknown by then. The Bureau of Plant Industry of the United States Department of Agriculture maintained a mild interest as shown by a giant variety of the bean which they obtained and distributed as *Ricinus communis* B.P.I. No. 49366, from Mexico—chiefly as a potential ornamental. Plants from these seeds are described in the MISSOURI BOTANICAL GARDEN BULLETIN, October, 1921, Vol. 19. This variety grew to a height of thirteen feet, but was very slow to produce seed. There was also a dwarf plant described, with the comment that its origin was unknown since it appeared as a solitary plant in 1920.

One might ask why this crop is not grown to-day. If it was profitable two generations ago why isn't it worth while now with the new uses for the oil? The answer lies in the cost of harvesting. As the plant grows upward it develops axillary flower spikes. The first one to appear matures, and a few weeks later another spike appears and matures in due time, and so on throughout the season. In Missouri, frost usually kills the plant while several spikes are immature and several others are ripe. Perhaps the great difficulty in harvesting the seed is best indicated by Professor Shaw (Bull. No. 54, Okla. Agr. Exp. Sta.) who, in 1902, wrote:

> Were it not for the fact that the natural opening of the pods and discharge of the seeds is made use of in shelling them, our first thought and endeavor would be to secure plants *on which the pods would not open at all, or better, would open only after the action of frost.* If in any way we could secure such plants, and at the same time provide some threshing device which would separate the seeds from the pods, the gathering of the crop would be cheapened and the seeds on large spikes would be given time to ripen more uniformly. The difficulties in the way of this solution are great, but the matter is worthy of some serious attention in connection with any series of experiments or studies on the plant.

In other words, it is necessary to go into the field each time a series of pods ripen and before the seeds shatter and fall to the ground. In a favor-

FRUITING CASTOR BEAN PLANT

able season some varieties will mature five spikes, which necessitates five trips through the fields. The labor involved in hand harvesting is probably the principal reason that the crop moved to other countries.

In 1920, a new castor bean called "Red Spire" was obtained for use as an ornamental at the Garden. This plant grows to a height of six feet, has bronze-green leaves, red ribs, and brilliant crimson spikes. Of all the varieties which have been tried as ornamentals this was the most satisfactory; it had good color, interesting seed, and did not exceed six feet in height when grown from seed planted directly in the field. Seed selection was started immediately, since relatively few seeds were needed when the plant was used as an ornamental. These were taken from *the pods which somehow held a few seeds and did not shatter completely.* After twenty-one years of selection, the castor bean we are now growing at the Arboretum as a field crop for seed production exhibits great uniformity and holds the seed tightly in the pods all through the winter if not harvested. In 1942, planting was finished July 7. Six days later the cotyledons appeared above ground, and

Field of Castor Beans growing at Garden Arboretum on August 6, the first flower spike opened. A sharp frost in early September killed the plants before seed was ripened. In 1943 planting was finished May 6, but germination was delayed until May 24 due to a wet cold spring. Growth was slow until June 11, when hot weather arrived, and within two weeks the first flower spike opened. A favorable fall allowed sufficient seed to ripen to plant 1½ acres in 1944. In that year planting was finished on May 15; the cotyledons appeared nine days later; the first flower spike appeared on June 13, the second on July 11, and the third on July 26. Since then planting has been done as early as possible in May, and the harvesting delayed until after a killing frost.

It is quite obvious from what has been written that the castor bean will not be successful in the Middle West unless it can be planted, cultivated, and harvested by machine. All the experimental work at the Arboretum has been directed toward adapting the crop to machine operation. All planting has been done with an ordinary two-row corn planter, slightly modified to handle the large soft seeds without crushing. The rows have been spaced 42 inches apart and the plants about 14 inches in the row. Cultivation at first was with a small garden tractor, but now it is done with a tractor-mounted row crop cultivator. Harvesting has been done with a combine without special equipment, although some additional work is needed here. The solution appears to be the use of a huller after the combine separates the seed with enveloping hulls from the rest of the plant in the field.

This variety seems to be at least partly the fulfillment of Professor Shaw's hope. In any event, the strain should be valuable in a breeding program, since a laboratory analysis of the extracted oil is quite favorable, and a yield test at the University of Illinois shows an average of 1,422 pounds of seed per acre.

The greens of late autumn.—Most of the green in our late autumn landscape comes from Europe. It is the European trees (the cultivated apple, the Scotch and English Elms, and English oaks) which still hold their leaves unwithered after our native ones have colored. Our native grasses are almost as bright in the fall as our native trees but few people notice that they too finish the season in brown and russet and purple. The green lawns of November are green with European grasses, creeping bent, and red top, and Kentucky blue grass (which is an introduced grass here in the eastern United States in spite of its common name).

TESTING SOME LOCAL FIREWOODS

ROBERT W. SCHERY AND DENNISON H. MOREY, JR.

On September 1, 1946, misfortune in the form of a "tornado" striking the Garden gave us opportunity to gather samples of many kinds of logs all "felled" on that memorable date. Diverse were the personal evaluations heard for these different types of (potential) fire logs, and uncertain was the opinion of even fireplace enthusiasts concerning many common woods not frequently marketed as firewood. Almost every one agreed that cherry, for instance, was better firewood than box elder, but no one could tell how much better or specifically why. Since no one had "statistics" for proving his contention, we decided to test these available woods objectively—to let measurement back up, or refute, opinion. The results of our tests and a numerical evaluation of all species tested are here presented for what they may be worth. Table 5 gives the total point score for all tested woods. But before outlining the details of these tests, we shall review briefly some known facts concerning wood as a fuel.

Wood substance, the cell walls of wood exclusive of its contained air, gives essentially equal quantity of heat upon burning for all kinds of wood (roughly 4 calories per gram of wood burned). That is to say, a pound of bone-dry wood, be it birch or oak or any other kind, will release equal quantities of heat, namely about 8600 B.t.u. Consequently, heavier logs, those with less air space in the cells, will release upon burning a greater quantity of heat; or, put another way, among logs of equal size, those with more cell-wall substance will produce the greater amount of heat. Heavier woods, then, are superior for quantity of heat.

Normally, firewood is never completely dry. When a fire log is first thrown on the fire, heat is used to expel the moisture—i.e., to "dry" the wood. This is the first phase in burning any log. The more moist the log the more heat will be required to evaporate the moisture and the less heat will then be released in burning. Very wet or "green" logs can be ignited only in very hot fires. "Green" wood is thus less suitable for firewood than is "seasoned" or drier wood.

In the second phase of the burning of a log the gases or volatile materials are expelled from the wood. These volatile materials consist of oils, resins, alcohols, and other extracts that are found in greater or lesser quantities in the cell walls of the wood cells. As the log heats they are vaporized into the gaseous form and are emitted from the log. They burn in the air to form the characteristic "flame" of a fire. Heat is required to distil or volatilize these materials, and this volatilization will reduce the efficiency of the fire unless it is hot enough to ignite all expelled gases which, in turn, produce heat in burning. Sufficient air, as well as high ignition temperature, must be present for the volatile materials to burn. If they fail to burn not only is their value as fuel lost, but also they may condense on the flue as a tar or creosote, a subsequent fire or corrosion hazard. Thus logs with lesser quantities of "resin", and this easily volatalized and ignited, are usually to be desired for firewood.

In the third and final phase in log burning the "coals" or embers burn. All volatile material has been released and the fixed carbon of the wood cell walls burns (glows) without flame as long as air is sufficient for combustion. The "coals" emit great quantities of heat which in this phase usually need not be diverted for evaporation of moisture nor volatilization of resins. Logs forming dense, lasting "coals" are therefore desirable for firewood.

Well-seasoned logs are a relatively efficient source of heat. A cord of a good, dry hardwood will produce more heat than a ton of coal (and less ash will remain afterwards). Moreover, wood is normally clean and easily handled, and when properly burned no objectionable smoke will result. But, as we have seen, to be efficient, it must be dry. Wood dries mostly from the end surface (i. e. cross section, cutting across the cells). Bark on a log hinders drying, and large logs must be split to permit drying of inner wood. For this reason, shorter logs of a kind easily split, that naturally contain or absorb little moisture, are those to be desired for firewood.

In our tests, all the logs were "harvested" on the same date by the "tornado." These felled logs were left outdoors, completely exposed to the elements from September 1 until December 15. Let us see what our simple tests revealed about several Missouri-grown hardwoods.

Test 1. Density in woods.—

From various sources the densities of the sample woods were ascertained. These densities are tabulated as Table 1. Density (or more precisely, specific gravity) indicates weight per unit volume—the weight of each wood compared to an equal volume of water. Those with a higher specific gravity, being heavier, are a potential source of more heat in burning. Reference to Table 1 shows us that of the nineteen wood types tested, judged solely on potential quantity of heat to be produced in burning, apple, black locust, Osage orange, and hawthorn are the best fire logs, while cottonwood, box elder, and catalpa are the poorest. Others, such as birch and silver maple, are intermediate.

TABLE I.—DENSITY (SPECIFIC GRAVITY) OF 19 KINDS OF WOOD TESTED AS FIRELOGS

Botanical name	Common name	Pounds per cubic feet	Density
Acer Negundo	Box Elder	26	0.41
Acer saccharinum	Silver Maple	34	0.54
Ailanthus altissima	Tree of Heaven	45	0.71
Betula nigra	River Birch	35	0.55
Catalpa speciosa	Catalpa	26	0.41
Crataegus sp.	Hawthorn	48	0.76
Evonymus Bungeana	Wahoo	42	0.66
Fraxinus sp.	Ash	42	0.66
Gleditsia triacanthos	Honey Locust	44	0.69
Maclura pomifera	Osage Orange	48	0.76
Malus sp.	Apple	51	0.80
Morus alba	Mulberry	47	0.74
Platanus occidentalis	Sycamore	36	0.57
Populus deltoides	Cottonwood Poplar	24	0.38
Prunus sp.	Cherry	36	0.57
Quercus palustris	Pin Oak	45	0.71
Robinia Pseudacacia	Black Locust	48	0.76
Sassafras variifolium	Sassafras	32	0.51
Ulmus americana	American Elm	34	0.54

Test 2. Moisture in the logs.—

"Greenness" of the logs after 2½-months exposure in the open was ascertained by weighing the samples, then thoroughly drying them in a constant-temperature oven[1] and reweighing. Comparison of the two weights permits calculation of the percentage of moisture in the logs at the beginning of the test. The results, tabulated in Table 2, show that the logs felled September 1 had been only slightly "seasoned" (i. e. had only partially dried out) by December 15. On that date they still contained 22–52 per cent moisture, which in many cases is only slightly less than the usual moisture content of comparable newly felled "green" wood. Definitely superior for firewood, on the basis of moisture content in these samples, were hawthorn, Osage orange and black locust, while definitely inferior were cottonwood, wahoo, box elder and birch.

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[1] That samples were completely oven-dried is indicated by the fact there was no weight loss in the dried samples between the December 19 and December 30 weighings. In fact, during this period samples showed a slight weight increase because they had been removed from the oven several hours prior to the December 30 weighing, and in these several hours had had opportunity to absorb some moisture from the air.

TABLE 2.—PERCENTAGE OF MOISTURE IN GREEN WOOD

Botanical name	Common name	Weight in grams			Per cent moisture Dec. 15
		Dec. 15 (before drying)	Dec. 19 (after 4 days in drying oven)	Dec. 30 (after 15 days in drying oven)	
Acer Negundo	Box Elder	66.1	38.6	39.4	41.6
Acer saccharinum	Silver Maple	62.5	38.15	39.0	38.9
Ailanthus altissima	Tree of Heaven	106.7	72.2	72.8	32.5
Betula nigra	River Birch	256.0	152.2	155.5	40.5
Catalpa speciosa	Catalpa	52.4	36.8	37.0	29.6
Crataegus sp.	Hawthorn	70.5	53.3	54.5	22.6
Evonymus Bungeana	Wahoo	74.7	42.7	43.2	42.9
Fraxinus sp.	Ash	254.1	180.6	184.5	29.0
Gleditsia triacanthos	Honey Locust	326.5	213.5	217.2	34.0
Maclura pomifera	Osage Orange	121.5	93.6	94.6	24.3
Malus sp.	Apple	201.6	125.4	126.8	37.9
Morus alba	Mulberry	75.3	47.2	48.1	37.4
Platanus occidentalis	Sycamore	61.0	44.2	45.0	27.6
Populus deltoides	Cottonwood Poplar	133.1	64.0	64.8	52.1
Prunus sp.	Cherry	130.6	92.2	93.5	29.4
Quercus palustris	Pin Oak	178.7	115.3	117.5	35.7
Robinia Pseudacacia	Black Locust	126.6	96.0	95.6	24.6
Sassafras variifolium	Sassafras	98.8	68.8	70.0	30.4
Ulmus americana	American Elm	114.7	83.7	85.5	26.1

Test 3. Ability of logs to ignite or kindle.—

Each of the samples, both in oven-dried state and as an "unseasoned" control, were mechanically held a standard distance above a constant gas flame for definite periods (timed with a stop-watch). The completely dry samples were subjected to the flame for three consecutive 15-second periods with 15-second intervals between exposures. Results are tabulated in Table 3A. If the sample continued burning throughout the interval the maximum full-time figure (15) is given. Observations after the final exposure to flame were continued up to 1 minute, and if the sample held a flame for this length of time (60 seconds) presumably it could continue burning. The "score" in the column to the right records our impression of the quality and quantity of flame produced, where 5 = highest, grading down to 1 = lowest.

"Unseasoned" woods, the undried control samples[1] from the same logs as tested in Table 3A, were given a similar test. Results are recorded in Table 3B. Samples were exposed to the same flame in the same manner as described in the previous paragraph, except that the exposure time was

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[1] Kept outdoors: at near freezing temperature when tested.

TABLE 3.—ABILITY OF LOGS TO IGNITE OR KINDLE WHEN EXPOSED TO STANDARDIZED GAS FLAME

A—SEASONED WOOD						B—UNSEASONED WOOD			
Botanical name	Common name	Exposures (15 sec.)*			"Score" of flame	First exposure (90 sec.)		Second exposure (120 sec.)	
		(1)	(2)	(3)		"Good" flame	Hold flame	Intensity smoke	Hold flame
Acer Negundo	Box Elder	15	15	15	3	40 sec.	0 sec.	2	0 sec.
Acer saccharinum	Silver Maple	15	15	60	5	30 "	0 "		5 "
Ailanthus altissima	Tree of Heaven	15	15	60	2	80 "	0 "	3	0 "
Betula nigra	River Birch	12	15	60	4	15 "	1 "		10 "
Catalpa speciosa	Catalpa	15	15	60	4	5 "	5 "	3	0 "
Crataegus sp.	Hawthorn	15	15	60	4	8 "	1 "		2 "
Euonymus Bungeana	Wahoo	15	15	60	3.5	40 "	0 "	2	0 "
Fraxinus sp.	Ash	15	15	60	3	40 "	0 "		1 "
Gleditsia triacanthos	Honey Locust	15	15	60	3	None	0 "	1	0 "
Maclura pomifera	Osage Orange	6	12	30	1	60 "	0 "	3	0 "
Malus sp.	Apple	2	15	60	3	90 "	0 "	3	0 "
Morus alba	Mulberry	12	15	60	2	65 "	0 "	2	0 "
Platanus occidentalis	Sycamore	15	15	60	4.5	45 "	0 "	1	0 "
Populus deltoides	Cottonwood Poplar	15	15	60	5	7 "	0 "	2	0 "
Prunus sp.	Cherry	15	15	60	3.5	10 "	1 "	3	0 "
Quercus palustris	Pin Oak	3	15	60	3	70 "	0 "	1	0 "
Robinia Pseudacacia	Black Locust	15	15	60	2	10 "	0 "	2	0 "
Sassafras variifolium	Sassafras	15	15	60	3.5	60 "	0 "	3	0 "
Ulmus americana	American Elm	15	15	60	4	15 "	0 "	2	0 "

*Figures in these columns indicate the number of seconds each sample held its flame after the gas flame was removed.

altered. The first period of exposure to the gas flame was 90 seconds, which was followed by a 120-second exposure after an interval of 15 seconds with gas flame removed. The first column to the left indicates the number of seconds elapsed during the first exposure period before a "good" visible flame appeared. Seldom was this flame maintained after withdrawal of the gas flame. Observations on flame maintenance are recorded in the second column from the left. In the second column from the right a "score" is given for intensity of smoke for those samples which did not "catch fire" after the second (2-minute) exposure to the gas flame. Scoring grades from 3 (= much smoke) down to 1 (= little smoke). The final column to the right records the number of seconds, if any, that the sample held its flame after final withdrawal of the gas flame. It will be noted that very few of these "unseasoned" samples were at all self-sustaining in flame.

Results of this test emphasize how superior any dry or "seasoned" wood is to any moist or "unseasoned" wood in ability to kindle or "catch fire." More than four times as much total exposure to gas flame was given the "unseasoned" woods as the "seasoned" woods, yet it will be noted that very few "unseasoned" woods caught fire at all, while almost all "seasoned" woods caught fire in a few seconds of exposure. This result overshadows slight differences in "kindlability" in equally seasoned samples, but among the types tested Osage orange, birch, apple and oak were most difficult to ignite (dry samples). Birch, catalpa and hawthorn seemed very slightly more flammable "unseasoned."

Test 4. Volatile materials and coaling qualities of woods.—

Dry samples of each of the woods were cut into blocks of 2.5 square cm., then burned in an electric furnace. The time necessary for all volatile material to be expelled (as indicated by duration of flame), and the total time necessary for complete reduction to ash (length of time coals endured) was ascertained. Results are given in Table 4, including an arbitrary ratio of fixed to volatile fuel substance (duration of coals divided by duration of flame). Cottonwood, mulberry and box elder seemed to have the least amount of volatile material per unit to volume of wood (and lesser fixed carbon substance as well): they, along with hawthorn and catalpa, would seem to be poorer fire woods on the basis of continued flame and lasting coals. On the other hand, Osage orange, honey locust, cherry, and black locust are superior (once ignited) in producing lasting coals, although under conditions of incomplete combustion of volatile materials they might cause some "creosote trouble."

TABLE 4.—VOLATILE MATERIALS AND COALING QUALITIES OF WOODS

Botanical name	Common name	Duration of flame[*]	Duration of coal[†]	Ratio[¶]
Acer Negundo	Box Elder	47 seconds	9 minutes	11.5
Acer saccharinum	Silver Maple	59 "	11 "	11.0
Ailanthus altissima	Tree of Heaven	56 "	13 "	13.9
Betula nigra	River Birch	50 "	12 "	15.4
Catalpa speciosa	Catalpa	57 "	8 "	8.4
Crataegus sp.	Hawthorn	49 "	9 "	11.0
Evonymus Bungeana	Wahoo	50 "	9½ "	11.4
Fraxinus sp.	Ash	59 "	13 "	13.2
Gleditsia triacanthos	Honey Locust	67 "	21½ "	19.3
Maclura pomifera	Osage Orange	63 "	23 "	21.9
Malus sp.	Apple	57 "	15 "	15.8
Morus alba	Mulberry	43 "	15 "	20.9
Platanus occidentalis	Sycamore	49 "	11 "	13.5
Populus deltoides	Cottonwood Poplar	44 "	8 "	10.9
Prunus sp.	Cherry	56 "	20 "	21.4
Quercus palustris	Pin Oak	55 "	14 "	15.3
Robinia Pseudacacia	Black Locust	65 "	16 "	14.4
Sassafras variifolium	Sassafras	52 "	10 "	11.5
Ulmus americana	American Elm	61 "	14 "	13.8

[*] Figures in this column indicate number of seconds flame endured (volatile materials produced) when sample was burned in an electric furnace—timed with stop-watch.

[†] Figures in this column indicate to nearest ½ minute the time sample remained a coal (not reduced to complete ash).

[¶] This ratio is of interest only for relative values. Absolute values (and even to some extent relative values) would be profoundly influenced by design of the furnace causing various degrees of exclusion of air from the coals.

Now, to select the best all-round firewood from among the samples tested, let us give credit to each for quantity in desirable characteristics. In Table 5 a total score is given for each sample, which was derived by arbitrarily allotting points as follows:

Density (indication of potential heat):

0.78–8.0 — 10 points
0.74–0.77 — 9 "
0.70–0.73 — 8 "
0.66–0.69 — 7 "
0.62–0.65 — 6 "
0.58–0.61 — 5 "
0.54–0.57 — 4 points
0.50–0.53 — 3 "
0.46–0.49 — 2 "
0.42–0.45 — 1 "
0.38–0.41 — 0 "

Moisture content of samples (indication of available heat and flammability):

22–25.9 per cent — 7 points
26–29.9 " " — 6 "
30–33.9 " " — 5 "
34–37.9 " " — 4 "
38–41.9 per cent — 3 points
42–45.9 " " — 2 "
46–49.9 " " — 1 "
50–53.9 " " — 0 "

Ability to kindle and quality of flame (as seen in Table 3):

Good .... 3 points
Moderately good ...... 2 "
Fair .... 1 "
Poor .... 0 "

Durability of coals (middle column, Table 4):

18–23 — 2 points
13–17.9 — 1 "
8–12.9 — 0 "

Ratio of fixed fuel to volatile substance (right column, Table 4):

20–22 — 3 points
16–19.9 — 2 "
12–15.9 — 1 "
8–11.9 — 0 "

A perfect score (highest number points in all categories) would thus be 25, and complete failure 0. Examining Table 5, we note, then, that Osage orange (with 21 points), black locust (20), and hawthorn (19) are the better all-round fire logs among our samples, while cottonwood poplar (2), followed by box elder (5), silver maple (9), catalpa (9), sassafras (10) and birch (10) are the poorest. Cherry, mulberry, apple, ash, honey locust, tree of heaven, and oak score as better-than-average firewood, while elm, sycamore and wahoo score as only moderately satisfactory. This, of course, does not indicate that these woods will always test best or poorest. Possibly even diferent branches from the same tree might have given slightly different scores

TABLE 5.—TOTAL POINT SCORE FOR EACH OF THE WOODS TESTED AS FIRE LOGS

Botanical name	Common name	Points					Total points
		Density	Moisture	Kindle	Coals	Ratio	
Acer Negundo	Box Elder	0	3	2	0	0	5
Acer saccharinum	Silver Maple	4	3	2	0	0	9
Ailanthus altissima	Tree of Heaven	8	5	1	1	1	16
Betula nigra	Black Birch	4	2	3	0	1	10
Catalpa speciosa	Catalpa	0	6	3	0	0	9
Crataegus sp.	Hawthorn	9	7	3	0	0	19
Evonymus Bungeana	Wahoo	7	2	2	0	0	11
Fraxinus sp.	Ash	7	6	2	1	1	17
Gleditsia triacanthos	Honey Locust	7	4	1	2	2	16
*Maclura pomifera**	Osage Orange	9	7	0	2	3	21
Malus sp.	Apple	10	4	1	1	1	17
Morus alba	Mulberry	9	4	1	1	3	18
Platanus occidentalis	Sycamore	4	6	2	0	1	13
Populus deltoides	Cottonwood Poplar	0	0	2	0	0	2
Prunus sp.	Cherry	4	6	3	2	3	18
Quercus palustris	Oak	8	4	1	1	1	15
Robinia Pseudacacia	Black Locust	9	7	2	1	1	20
Sassafras variifolium	Sassafras	3	5	2	0	0	10
Ulmus americana	American Elm	4	6	2	1	1	14

* Osage orange may be somewhat undesirable in spite of its high point score because of its tendency to throw sparks. Caution should be taken to place an adequate firescreen in front of the fireplace when the wood is burned.

if, for instance, one may have been partially dead before felling. Likewise, these tests were run only once, unconfirmed by subsequent checking. Undeniably, error often occurred in measuring; for example, samples used in Test 4 could not always be cut to exactly 2.5 sq. cm. on our power saw. Yet, in spite of the many defects and uncertainties, we hope that we have backed up with figures an inherent but unanalyzed knowledge of fuel wood that addicts of wood fire have come by naturally.

AN ORCHID ODDITY

R. J. SEIBERT[1]

One should never underestimate the powers of nature in the plant kingdom. Already we are familiar with some of them in the orchid family, namely, special adaptations such as epiphytic growth and the symbiotic[2] relationship between certain fungi and orchid roots. I wonder, though, how many know that some orchids can rather readily change their sex. As you know, some plant species are characterized by having separate male and female flower-producing plants, for instance, the holly. In other plants, such as the cat-tail, both male and female flowers are produced on the same plants. Still others, in fact most plants, produce perfect flowers containing both the male and female parts. The orchid *Catasetum saccatum* Lindl. can do all of these in the same plant.

During June, 1945, I was in the Madre de Dios Department of Peru, searching the jungles for superior strains of the Hevea rubbertree for plantation use. After a particularly exasperating day, I turned for a moment to examine a palm tree, *Scheelea* sp., whose fruit indicated that it might be of more than passing interest as a source of vegetable oil. During the examination of the palm trunk, a rather large epiphytic orchid plant with pseudobulbs about 10 inches long and 1½ inches in diameter revealed itself. The plant bore an erect spike of some four or five large cup-shaped waxy green female flowers. The petals were normally very small, somewhat purplish in color, and inconspicuous in the light of the somewhat oversized labellum, some 2 inches long and over 1 inch in diameter. As a thing of beauty this orchid plant left much to be desired, but as it was from a region botanically unexplored it was collected more as a curiosity than for its value as a shoulder-piece. By mule, on foot, and finally by air, the plant was taken back over the Andes to Lima, where I potted it in fern roots in a home-made bamboo pot. After a year in Lima it started to send out a spike, in June, 1946, about the time I was ready to return to the States.

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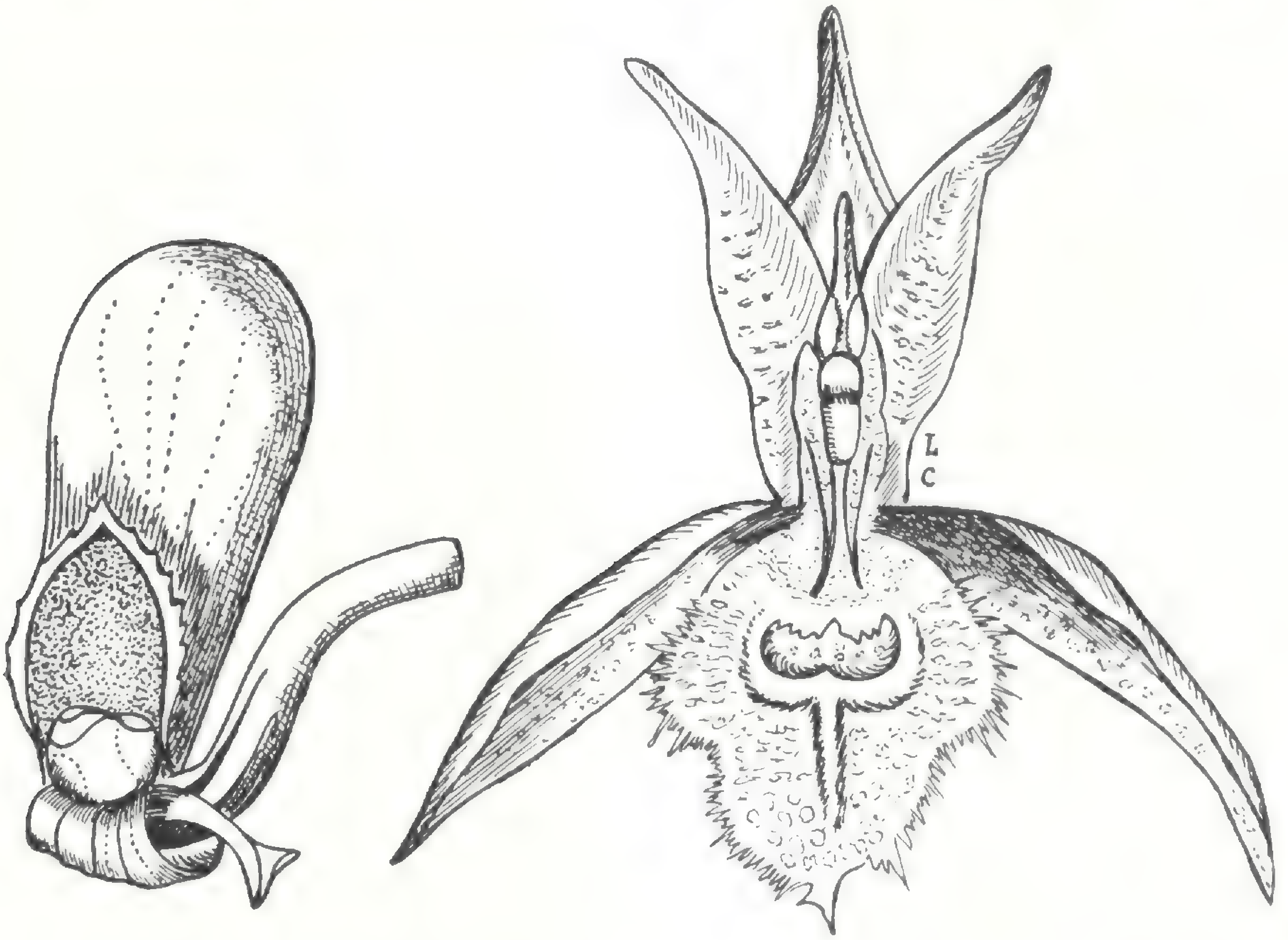
[1] Agent (Botanist), Rubber Plant Investigations, Bureau of Plant Industry, Soils and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture.

[2] Symbiosis is the living together of unlike organisms, with benefit to one or the other, or both.

Packing and shipping the plant from Lima to the Missouri Botanical Garden damaged the young spike. However, it recuperated after a year at the Garden, and on June 20 of this year it burst forth into a beautiful cascade of bloom. It was then identified as *Catasetum saccatum* Lindl. Neither rough handling, climatic conditions, nor change of hemisphere will apparently keep the plant from blossoming in June. The amazing thing, however, is that the same plant which sent out female flowers in Peru decided to produce male flowers in St. Louis. The male inflorescence and flowers are entirely different and seemingly unrelated to those of the female. Here the spike is pendent, with 20 very attractive flowers, deep rust-purple with light spots. They are each about 2½ inches in diameter, with the attractive petals the conspicuous feature rather than an ugly labellum. Another unusual thing that this plant did was to bloom again, two months later, and that time the flowering spike carried 22 flowers.



Female flower (left figure) and male flower (right) produced on the same plant of *Catasetum saccatum* in different years.

Catasetum saccatum and other members of the genus have the power to produce more or less readily either male or female flowers in different years.

The flowers of each sex are so utterly different in structure and beauty as seemingly to come from entirely different species. Still another freak condition is reported to occur in this genus; that is, on rare occasions the plant will produce a perfect flower which takes on still a different aspect from that of the other two types.

We know little concerning the reasons for such radical changes of expression in plants. Perhaps in this case it was due to being moved from Peru to Missouri? As they say in Peru, "Quien sabe?"

THE SWAN ORCHID *(CYCNOCHES VENTRICOSUM)*

PAUL H. ALLEN

The genus Cycnoches numbers in its ranks some of the most remarkable and perplexing of known orchids, producing staminate, pistilate, and hermaphroditic flowers which sometimes bear only the slightest resemblance to one another. The fact that plants were flowered in European greenhouses at about the time when Darwin, Lindley, and others were engaged in studies on the species problem caused widespread consternation, for here were plants which could produce at successive flowerings blooms of such widely divergent structure as seemingly to demand separation into distinct genera. Further careful observation of plants under cultivation soon disclosed that the Swan Orchids could be separated into two well-marked groups of species. In the first of these the dimorphism of the male and female flowers was extreme, with pronounced differences in size, structure and coloration, while in the second group the staminate and pistillate forms differ only in the shape and nature of the column, the other floral segments being essentially identical in size, texture, and coloration. The subject of the illustration is the largest and most striking example of the former group, ranging from Guatemala through the lowlands of Central America to Colombia and Venezuela.[1]

The slender, cylindric pseudobulbs are sheathed during the growing season by thin, green, plicate (folded into plaits) leaves which are deciduous, the persistent basal portions drying silvery white. Average plants are 9–12 inches in height, but individuals whose roots have come in contact with rotten wood exhibit the same phenomenon observed in other orchid genera in that titanic specimens develop, often over 30 inches tall. Since the potential number of inflorescences is determined by the number of available

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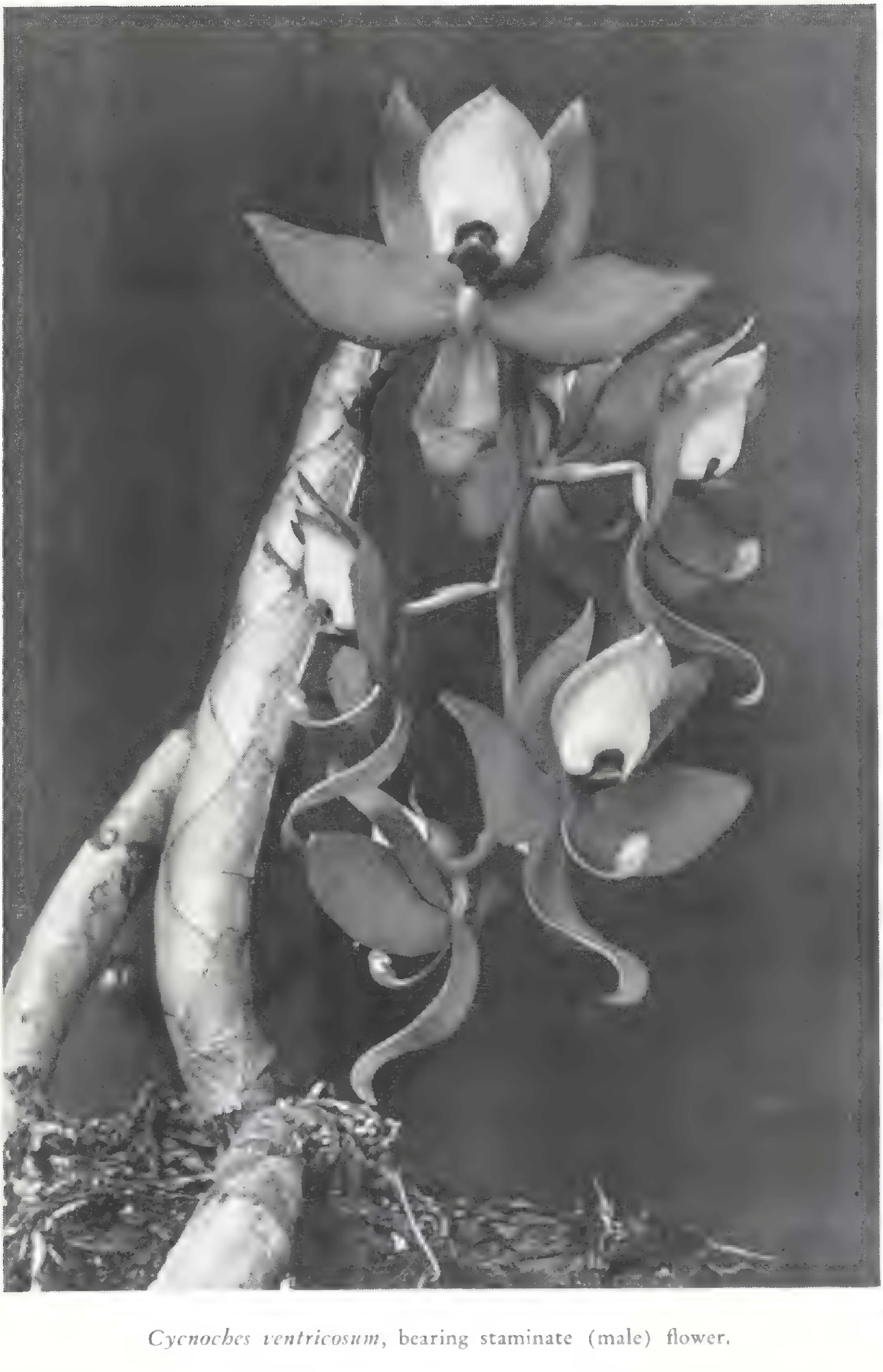
[1] If photographs and plates determined by recognized authorities are to be trusted, the plants known variously as *C. ventricosum*, *C. Warscewiczii* and *C. chlorochilum* are identical. The name *ventricosum* proposed in 1837 by Bateman would have priority of publication over the other two.



Cycnoches ventricosum, bearing staminate (male) flower.

leaf axils, these monster plants are very free-flowering, and as many as nine spikes are produced in succession from the topmost leaf axil downward. These arching scapes consist of from 3 to 9 large and attractive flowers, which average 5 inches in diameter, the staminate form being most commonly seen. The sepals and petals are pale green when they first open but become greenish-yellow with age, the lip pure white, with a black-green depression below the ventricose disk.

The common name of Swan Orchid has been suggested by the slender, curved column. The flowers have a heavy and delightful fragrance during the morning hours. When in bloom they are one of the most beautiful objects to be met with in nature, combining delicacy of coloring with exquisite form and fragrance. Initial experiments conducted over several years to maintain the extra size of collected plants found on rotton wood were not a success since direct potting with such material could not provide permanent firmness. Recent trials, in which the plants were securely wired to blocks of tree fern, in baskets which were then filled with pieces of decaying wood, have been a complete success on the twelve moderate-sized plants available for the test. Normal plants grow well in small pots, with Osmunda fiber, and shifting every other year is recommended since Cycnoches seldom retains more than one sound pseudobulb back of the current season's growth.

NOTES

Dr. Henry N. Andrews, Paleobotanist to the Garden and for the past three years Assistant to the Director, has been appointed Dean of the Henry Shaw School of Botany.

The third number of Volume 34 of the ANNALS OF THE MISSOURI BOTANICAL GARDEN has been issued, containing the following papers: Monograph of the North American Species of Corydalis, by Gerald B. Ownbey; A Study of Hevea, with Its Economic Aspects, in the Republic of Peru, by Russell J. Seibert.

Dr. Russell J. Seibert, Botanist, Division of Rubber Plant Investigations, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture, is spending some time at the Garden before taking up his position at Turrialba, Costa Rica, where our government maintains a rubber experiment station.

In driving through the farm country along the Missouri River which was so extensively flooded last spring, it was interesting to note how very susceptible are certain trees and shrubs to flood damage. The cultivated sour cherry was most easily damaged, with lilacs a close second. Around several farmsteads which were under water for only a short time the cherry trees were all killed outright but other trees and shrubs now look essentially sound.

Recent visitors to the Garden include: Sr. Alfredo Amescua, of Mexico City; Mr. Frank Barger, Landscape Gardener, Monrovia, Calif.; Dr. William L. Brown, Geneticist, Pioneer Hi-Bred Corn Co., Johnston, Iowa; Mr. Eric Halbinger, orchid fancier, of Mexico City; Mr. Gordon Haskell, from the John Innes Horticultural Institution, Merton, England, now Graduate Fellow in Genetics and Plant Breeding, of the Agricultural Research Council of Great Britain; Mr. Raymond Hogshead, tropical plant grower, North Miami, Fla.; Dr. George Thomas Johnson, Assistant Professor of Botany, Massachusetts Institute of Technology, Boston, Mass.; Mr. and Mrs. Richard Neutra, of Los Angeles, Calif.; Mr. B. C. Smith, assistant in the department of floriculture, Cornell University, Ithaca, N. Y.; Dr. Louis O. Williams, Botanist, United Fruit Co., Tegucigalpa, Honduras, C. A.

Dr. G. A. L. Mehlquist, Research Horticulturist to the Garden, has returned from England where he spent three months on a John Simon Guggenheim Fellowship grant, studying certain cytological and genetical problems of orchid breeding. From the John Innes Horticultural Institution, Merton, where he made his headquarters, he made trips to most of the commercial orchid nurseries and many private estates. The Royal Horticultural Society generously furnished him a Fellow's pass for the fortnightly exhibitions in London and the Trial Gardens at Wisley. Dr. Mehlquist also spent some time in Belgium, Denmark, and Sweden, where he visited botanical gardens and horticultural establishments.

Croton capitatus is a common weed of waste places and old fields, which, like many other members of the spurge family, has three large seeds, close together in one seed-pod, almost like a pawn-broker's sign. In Missouri its special virtues seem to have escaped attention but farther south in Texas and Arkansas it is respected as an excellent game food. In some places it is even becoming generally known as "Dove-seed" because the Mourning Doves feed so commonly on it during the autumn and early winter.

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

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Missouri Botanical
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AMERICAN HOLLY

PAUL A. KOHL

Here in the Missouri Botanical Garden, and even more in Tower Grove Park, are groups of American Holly, *Ilex opaca,* which were planted many years ago. For more than fifty years these trees have survived all the variations in temperature from extreme cold to excessive heat, drought, storms, and the smoke palls which occurred each year up until 1940. The value of the American Holly as a broad-leaved evergreen for this part of the country was recognized early in the history of the Garden and Park, and we find the following interesting comment on Christmas holly in the annual report of Tower Grove Park for the year ending December 31, 1900:

> The experience of a third of a century in caring for the trees in the Park has developed the fact that most of the conifers are destined to be ultimately lost, or at most to eke out a precarious existence, in the trying climate of St. Louis. The evergreen Christmas holly *(Ilex opaca),* in combination with other trees of persistent foliage, will doubtless be used in replacing these inevitable losses. With its green leaves and red berries, this holly forms a striking effect, and is calculated to lend as great a charm to the winter landscape as most of the somber conifers are capable of giving.

The native habitat of American Holly is along the eastern seaboard from Massachusetts to Florida and inland as far as Texas. In Gray's "Manual of Botany" and Rehder's "Manual of Cultivated Trees and Shrubs," *Ilex opaca* is listed as native to southeastern Missouri, and Steyermark, in his "Spring Flowers of Missouri," states that it is almost extinct in this state and should be protected from ruthless or thoughtless destruction. Since the natural range of this evergreen holly extends into Missouri one wonders why it was used here so little in landscape plantings until recent years. Was it because of the slow growth in the juvenile stage, the inability to distinguish between the staminate and pistillate trees until they were ten or more years old, or was it possibly its association only as a source of Christmas greens? Whatever the reason, it is quite evident that very few hollies were grown in St.

Louis after the initial plantings in the Garden and Tower Grove Park, some time between 1875 and 1900.

Formerly hollies were grown either from seed, collected in the woods, or were grafted to obtain fruiting trees. Vegetative propagation by means of cuttings was difficult and not many were grown by that method until 1929, when Zimmerman and Hitchcock's work[1] prepared the way towards a more satisfactory method of propagation. In 1936, the process of rooting holly was simplified still more through the use of growth-inducing substances which was also reported by the authors just mentioned[2]. Now any evergreen holly, staminate or pistillate, selected or named variety, can be rooted with little trouble.

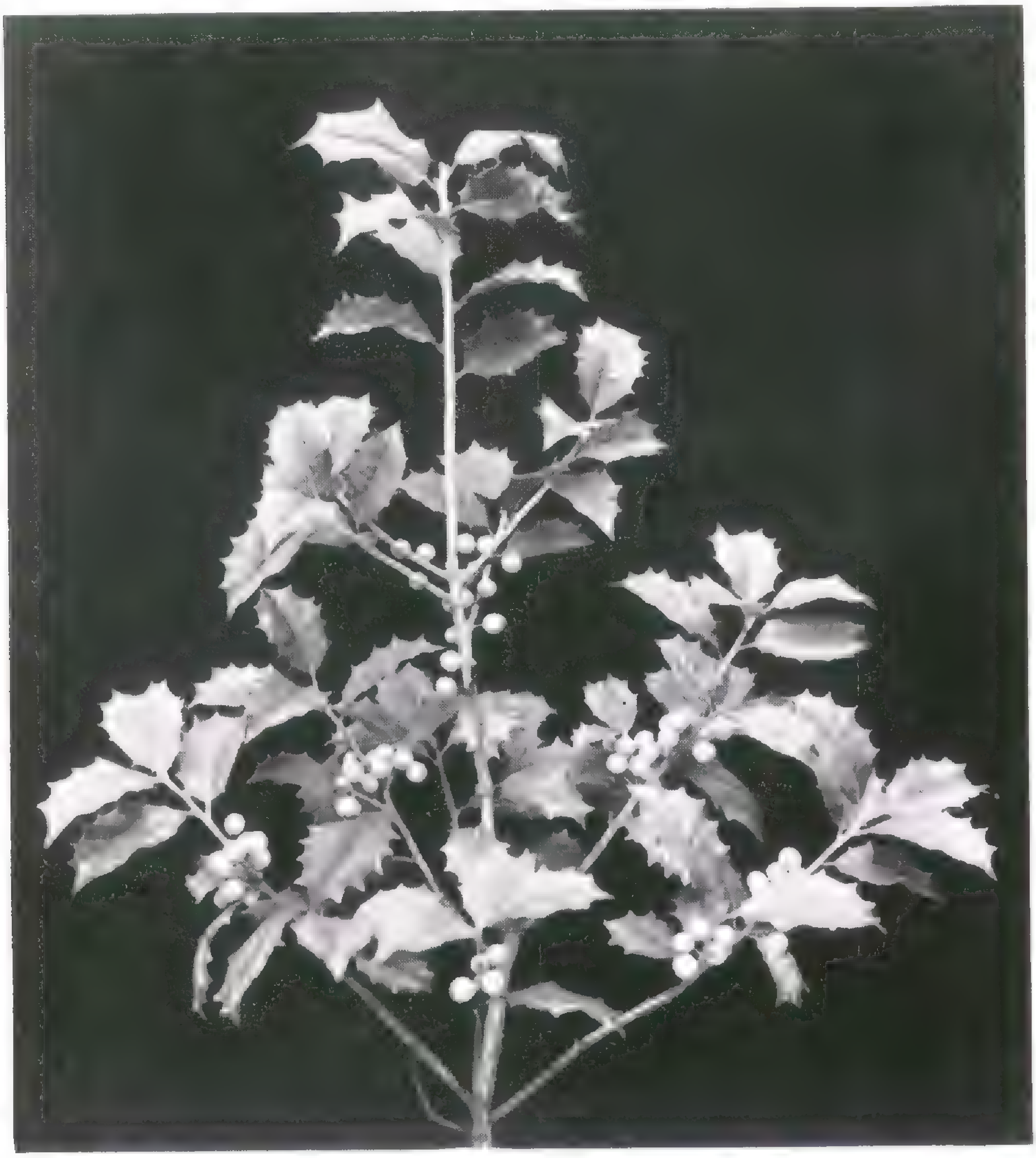

Fig. 1. Spray of American Holly *(Ilex opaca)*

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[1] Zimmerman, P. W., and A. E. Hitchcock. Vegetative propagation of Holly. Contributions from Boyce Thompson Institute for Plant Research. Vol. 2, No. 4. November, 1929.

[2] In Contr. Boyce Thompson Inst. Vol. 8, No. 1. 1936.

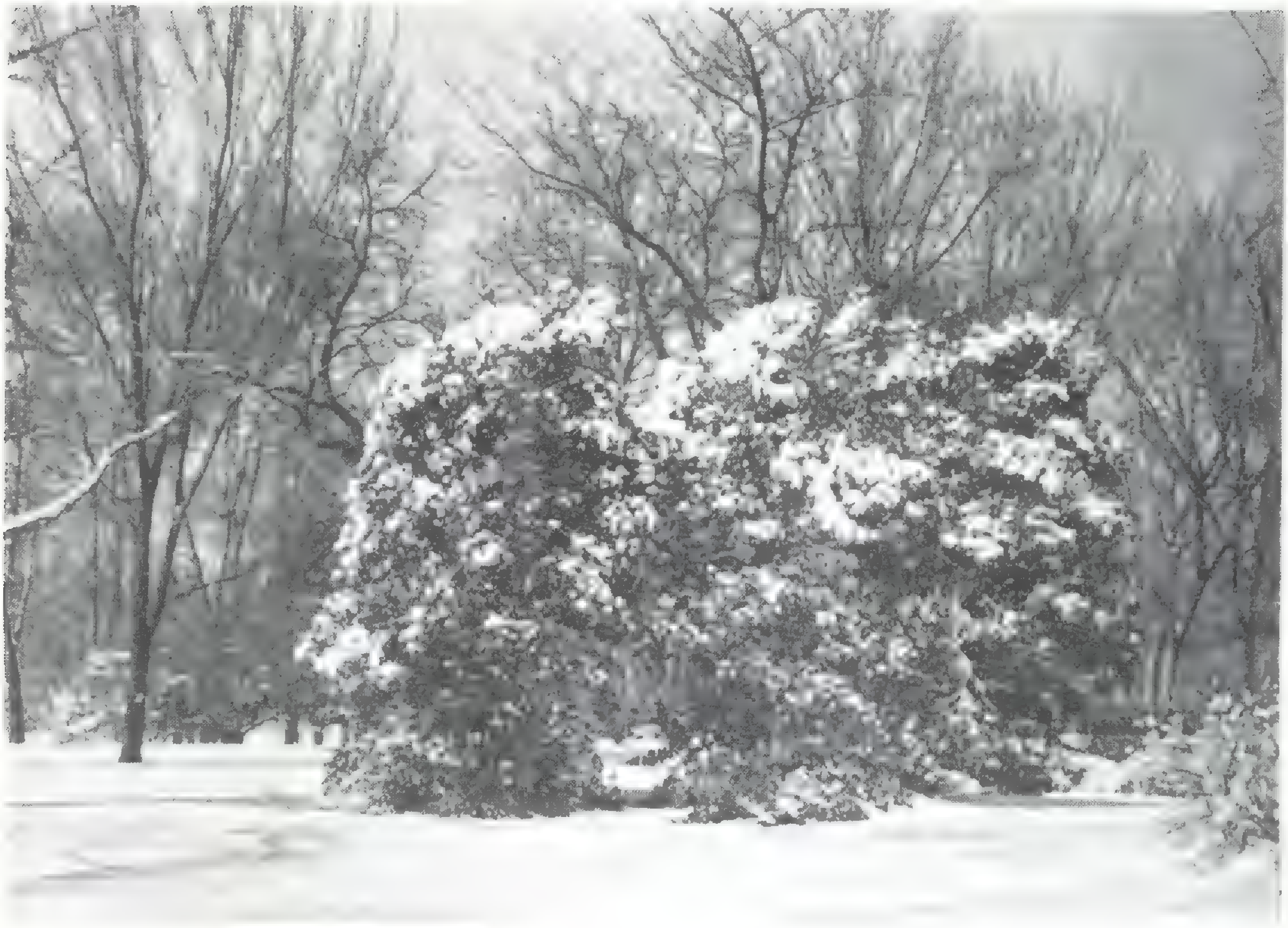

Fig. 2. Group of hollies in the Missouri Botanical Garden

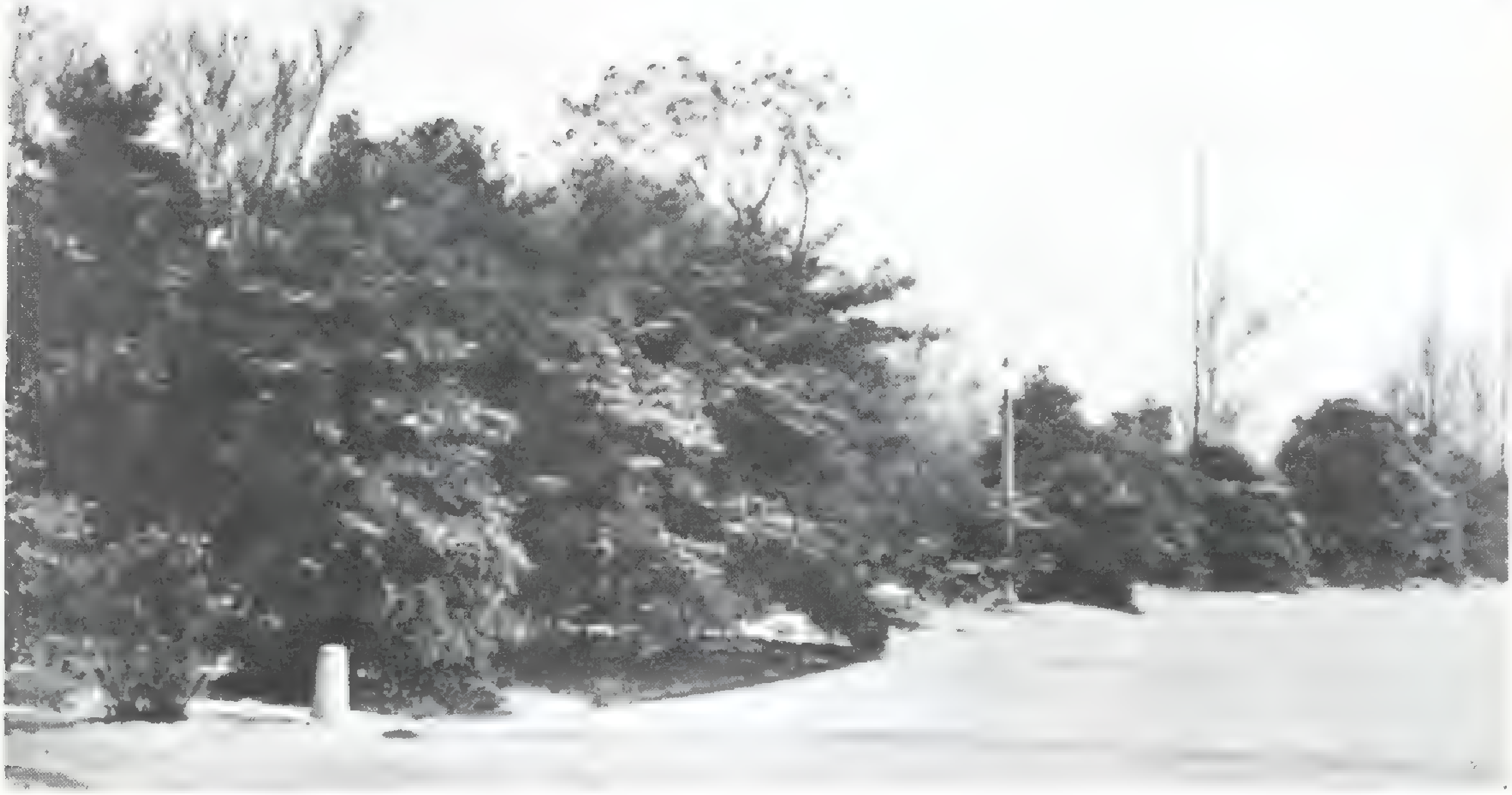

Fig. 3. American Holly in Tower Grove Park

Much interest in the American Holly is centered in Maryland and New Jersey, and only a few months ago the Holly Society of America was formally organized in Baltimore. In recent years holly experts in the East have preserved and propagated varieties which they have selected for their superior qualities. A few of these named varieties are "Arden," "Clark," "Croonenberg," "Delia Bradley," "Hume No. 1," "Hume No. 2," "Merry Christmas," "Mrs. Santa," "Pitman," and "St. Mary," and these may now be secured from a few eastern nurseries. In succeeding years it will be possible to compare these varieties with the types which have been growing here, but there is little doubt that if seedling trees flourished in this region the named varieties will grow as well.

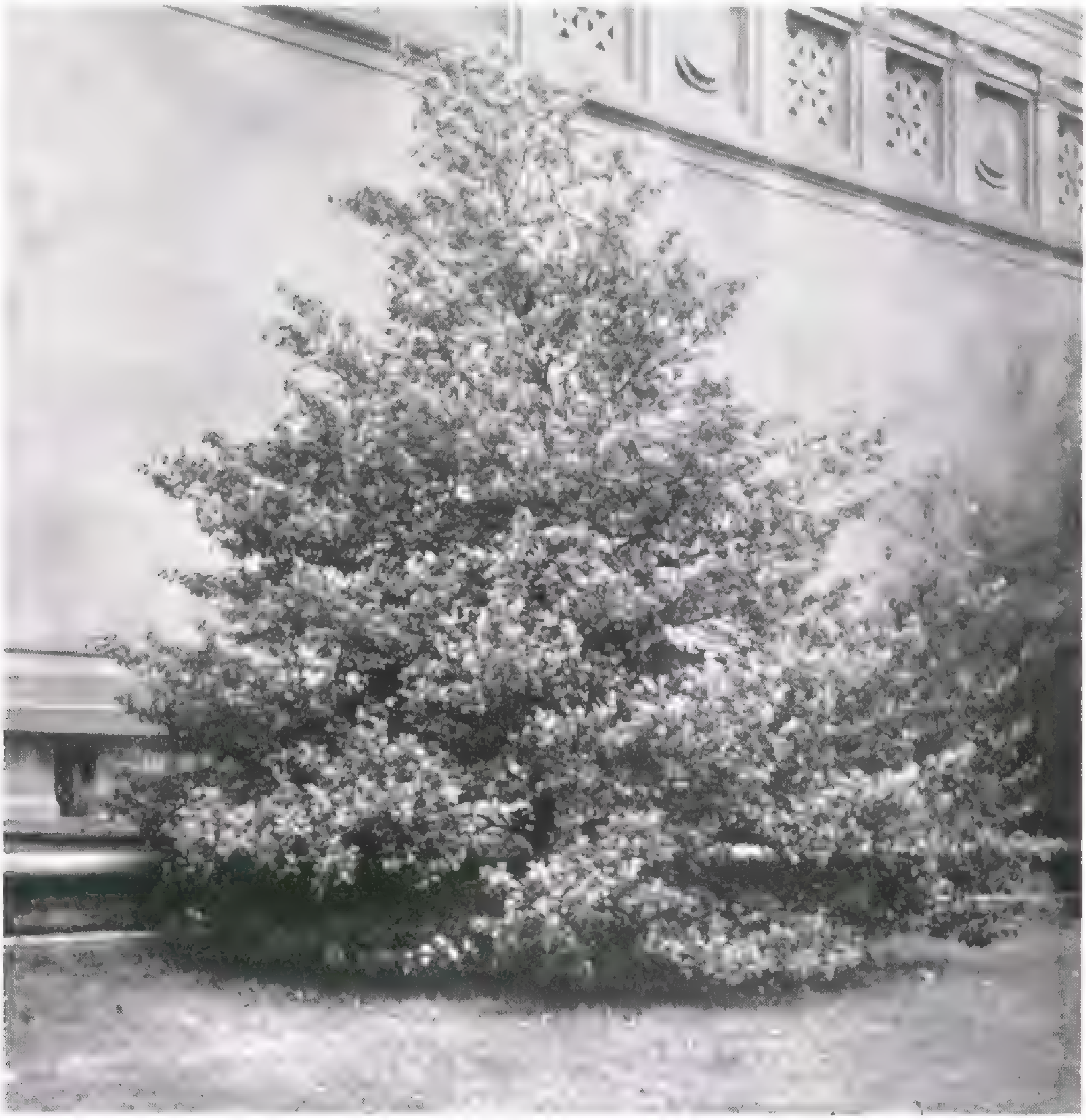

Fig. 4. Holly tree in front of Art Museum in Forest Park

Hollies grow best in the open and those that are planted in heavy shade or those that have gradually become covered by the branches of the faster-growing deciduous trees will lose many of their leaves and be very spindly.

Hollies retain their leaves throughout the year except for the few weeks in April when the new growths appear.

The hole in which the holly is to be planted should be dug at least three feet across and equally as deep. Three to four bushels of oak leaf mold or peat moss should be mixed with the soil that is removed, and all of it returned to the hole and firmed. Not one, but several, hollies should be planted to insure a crop of berries. Some trees are staminate (or male), but only the pistillate (female) trees will fruit if a staminate tree is in the vicinity from which the insects can carry the pollen. The prospective purchaser should have the assurance of the nurseryman that the trees he is ordering are the berry-bearing kind, and if no hollies are growing in the neighborhood, at least one or two staminate trees should also be planted. It is not known what the distance between a staminate and pistillate tree must be to insure pollination, but apparently it can be greater than one would suppose. For example, here in the Garden we have a group of three old hollies which fruit well each year, with the only staminate tree two-hundred feet away.

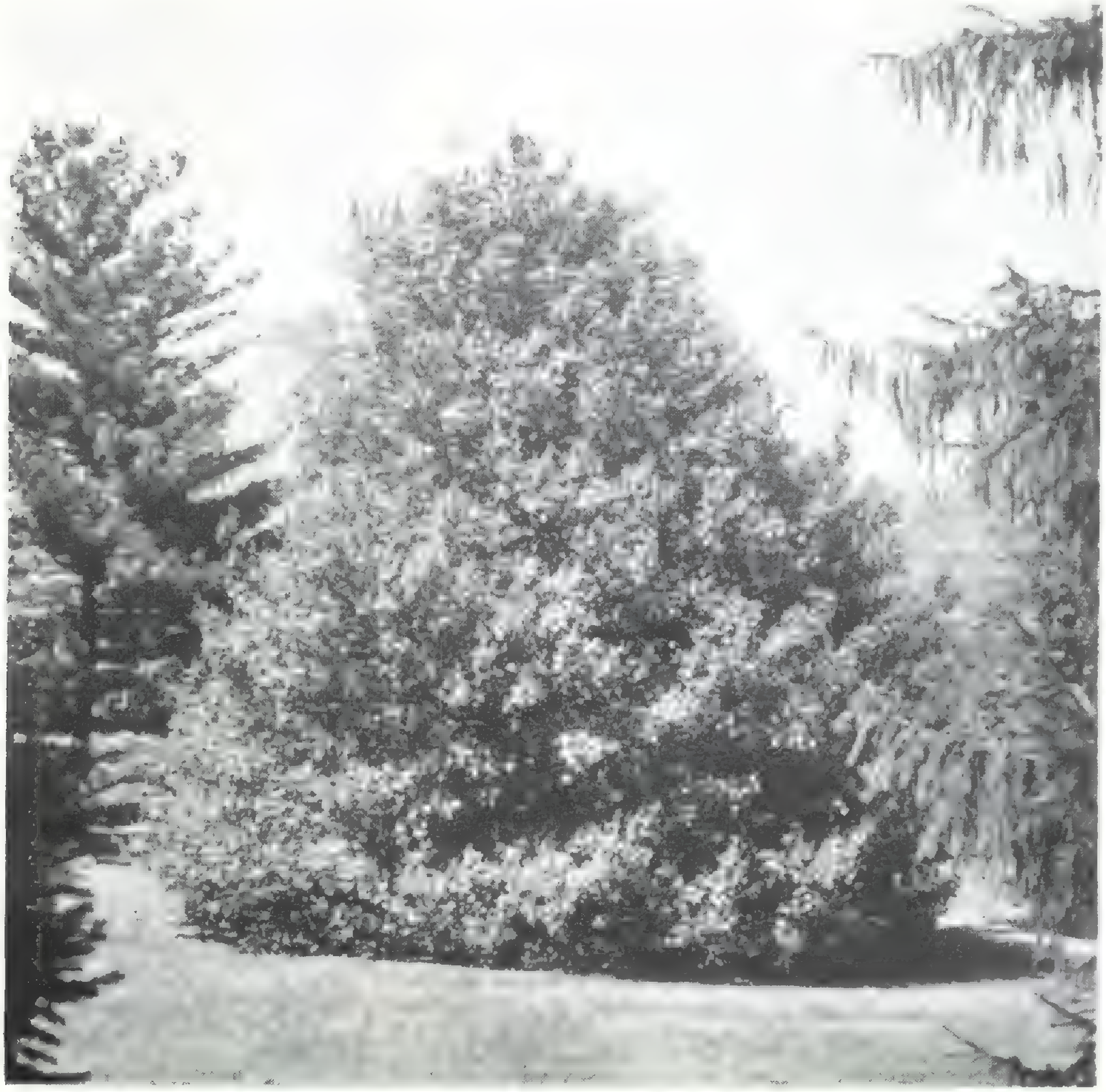

Fig. 5. Specimen of American Holly in St. Louis County

The best time to plant hollies in the St. Louis area is in late March or early April, or in September or October. However, planting may be done any time between these two periods if the ball of earth around the roots is firm and moist. Firm planting, with a depression left around the tree for watering, and a constant mulch of leaves or peat moss to conserve moisture are the important points to remember in setting out a holly. It is sometimes suggested that a tree be defoliated when it is transplanted. This is recommended if a holly is shipped without soil, as is required by some states, or if the ball is accidentally broken; otherwise it is not necessary. Removing holly leaves is tedious and must be done with small pruning shears or scissors.

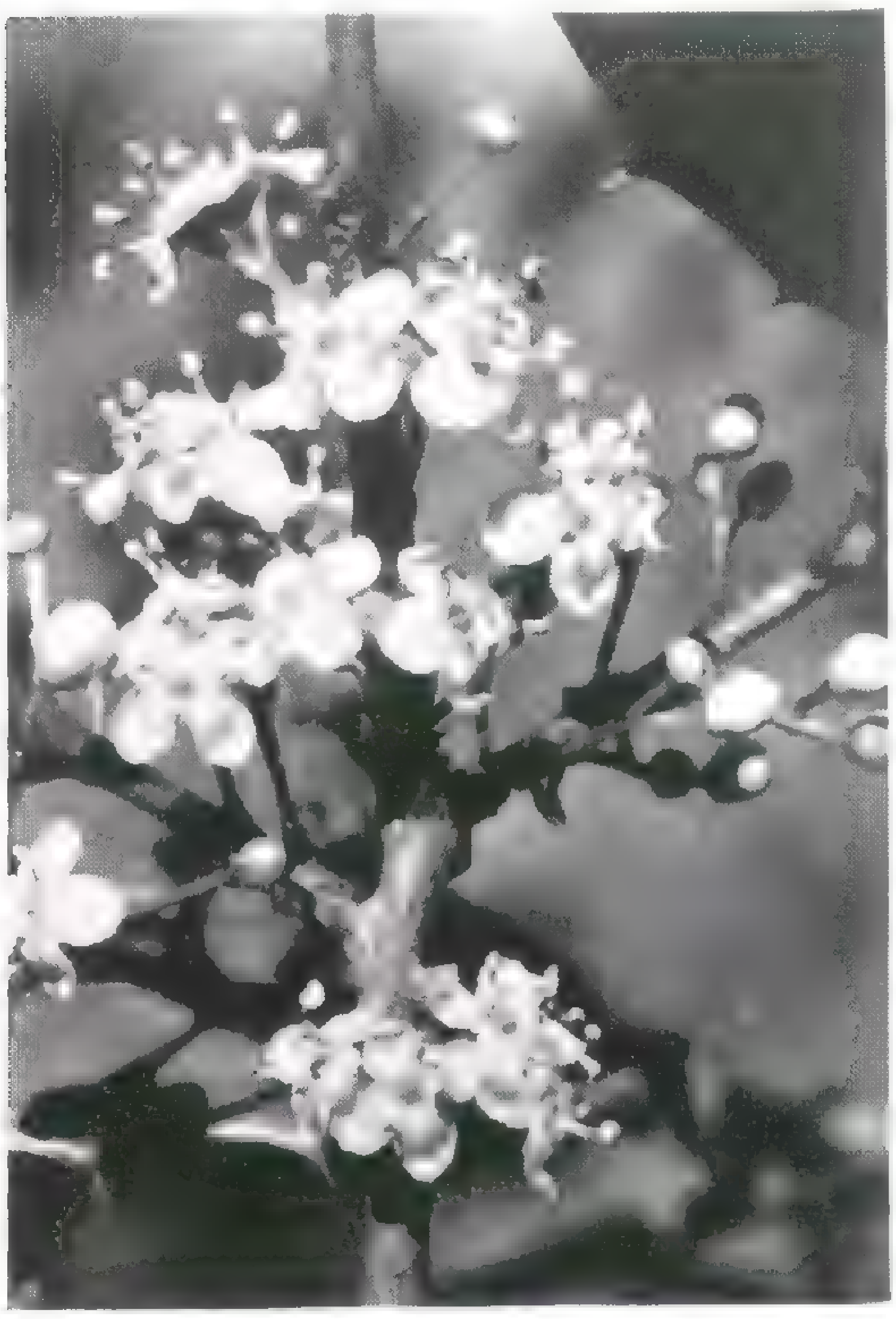

Fig. 6. Staminate (male) holly flowers

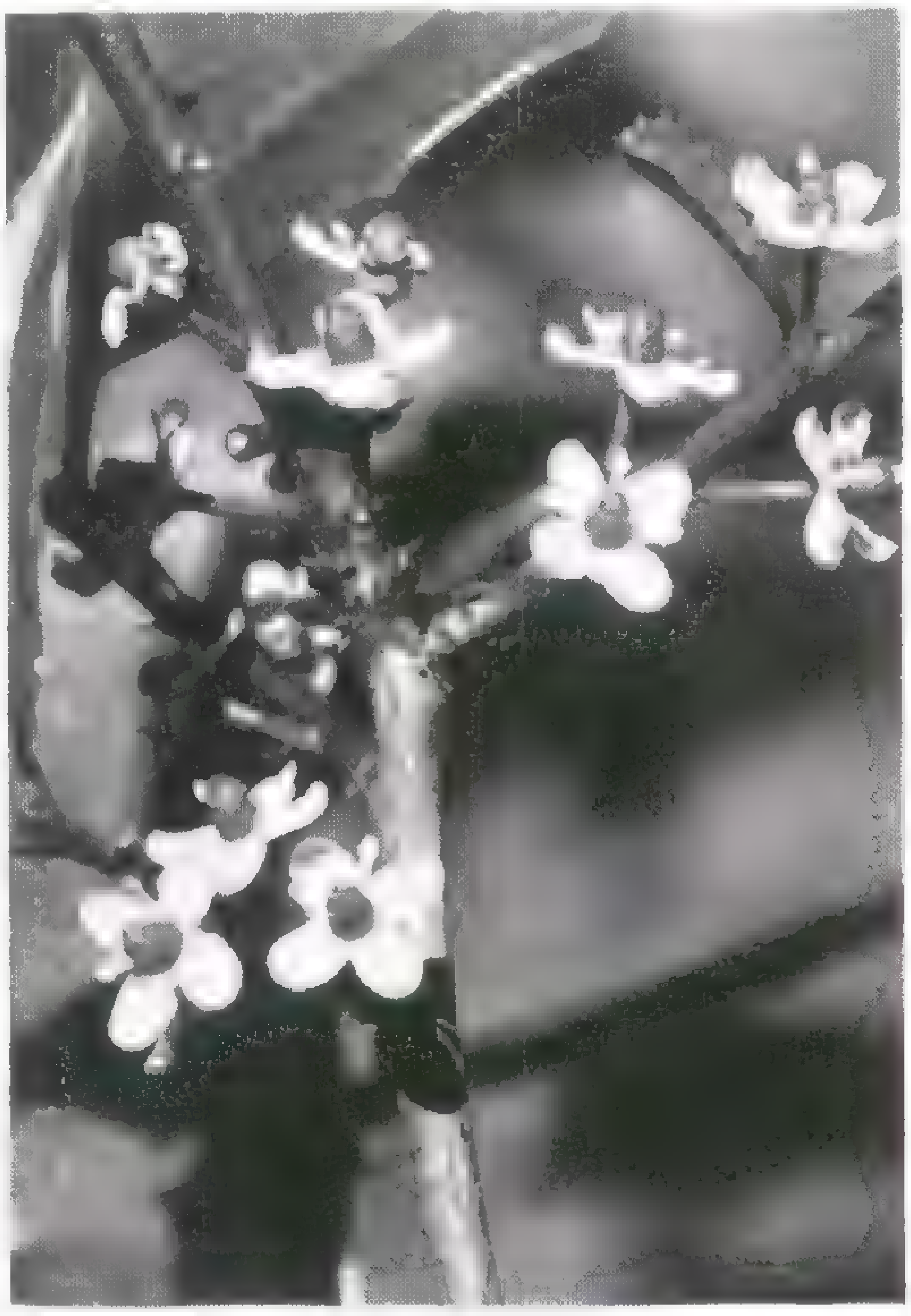

Fig. 7. Pistillate (female) holly flowers

Holly flowers are cream-colored and about three-sixteenths of an inch in diameter. They appear in April along the base of the new shoots, the staminate flowers in clusters and the pistillate ones on individual stalks. The berries are green during the summer, yellow-green in October, and bright red the first of November. Holly berries are bitter and are ignored by the birds until all other food is gone. In most years the berries remain on the trees until spring, but cedar-waxwings and robins have been known to strip the trees in a few days in late winter when their normal food was coated with ice.

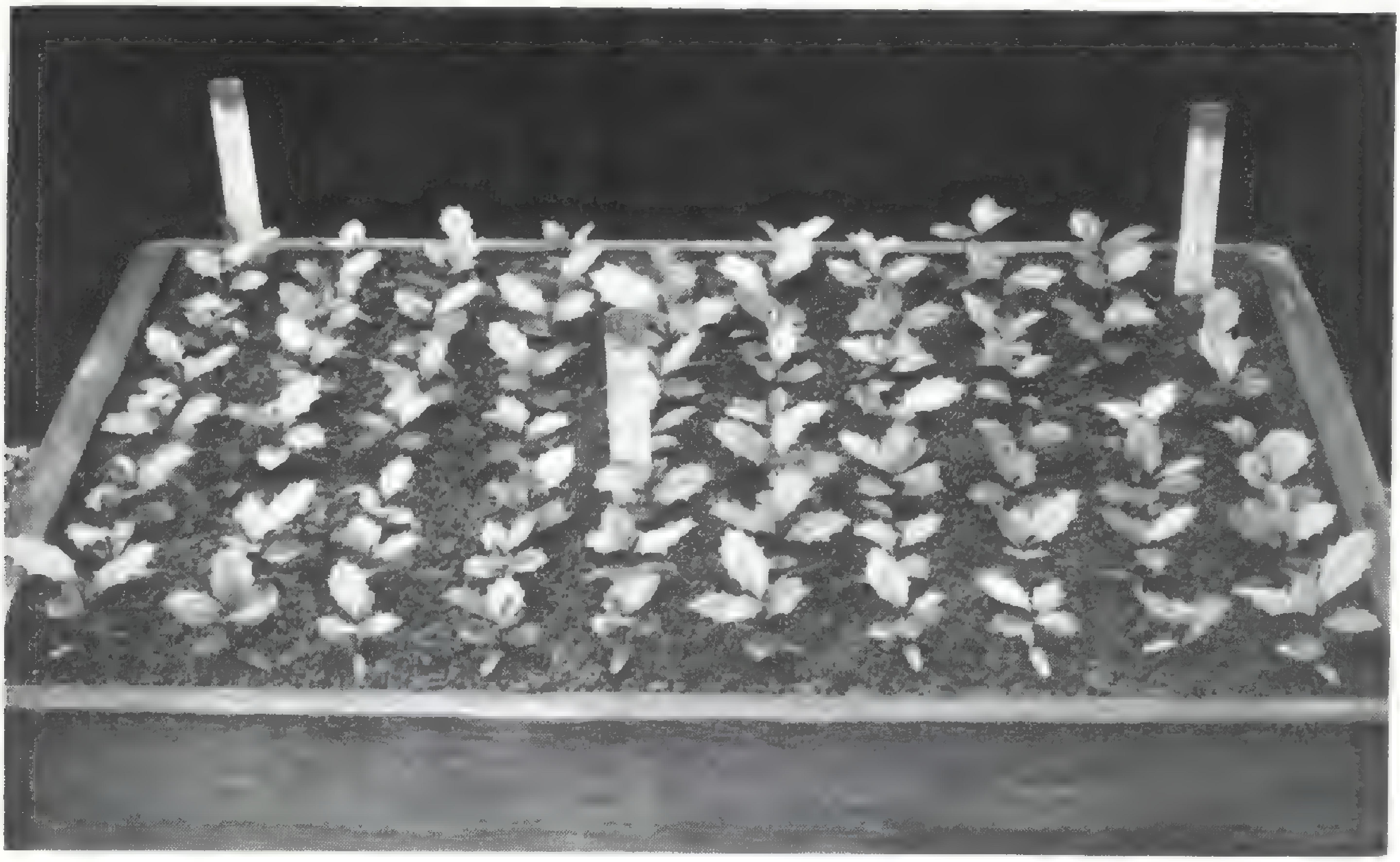

Fig. 8. Transplanted holly seedlings

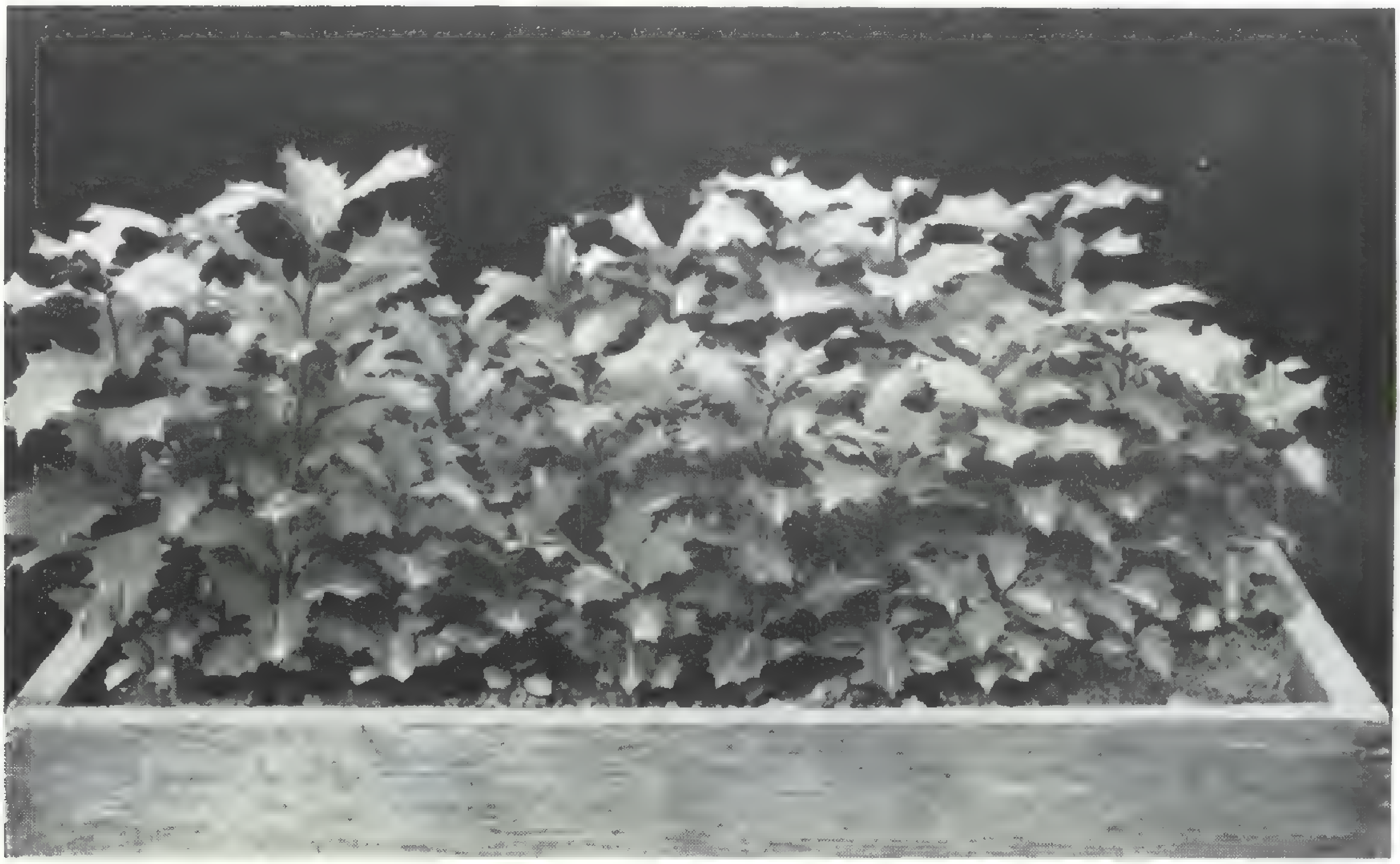

Fig. 9. Same seedlings six months later

Almost every young holly needs some pruning until it assumes the desired shape. Long branches should be cut and if the tree lacks a leader one should be encouraged to grow by shortening the laterals. If a holly tree has too many leaders, giving it the appearance of a shrub, most of them ought to be removed at the base of the plant. It takes a holly about three years to adjust itself to the new location, and after that one or several leaders will grow about a foot each year until the tree reaches a height of fifteen to twenty feet. From then on almost all of the vertical growth ceases, but the tree becomes dense and broad.

Feeding a holly is beneficial, but it must not be overdone with the idea of hastening its growth. An annual mulch of oak leaf mold is very good, and this may be supplemented with cottonseed meal, very old manure, or tankage.

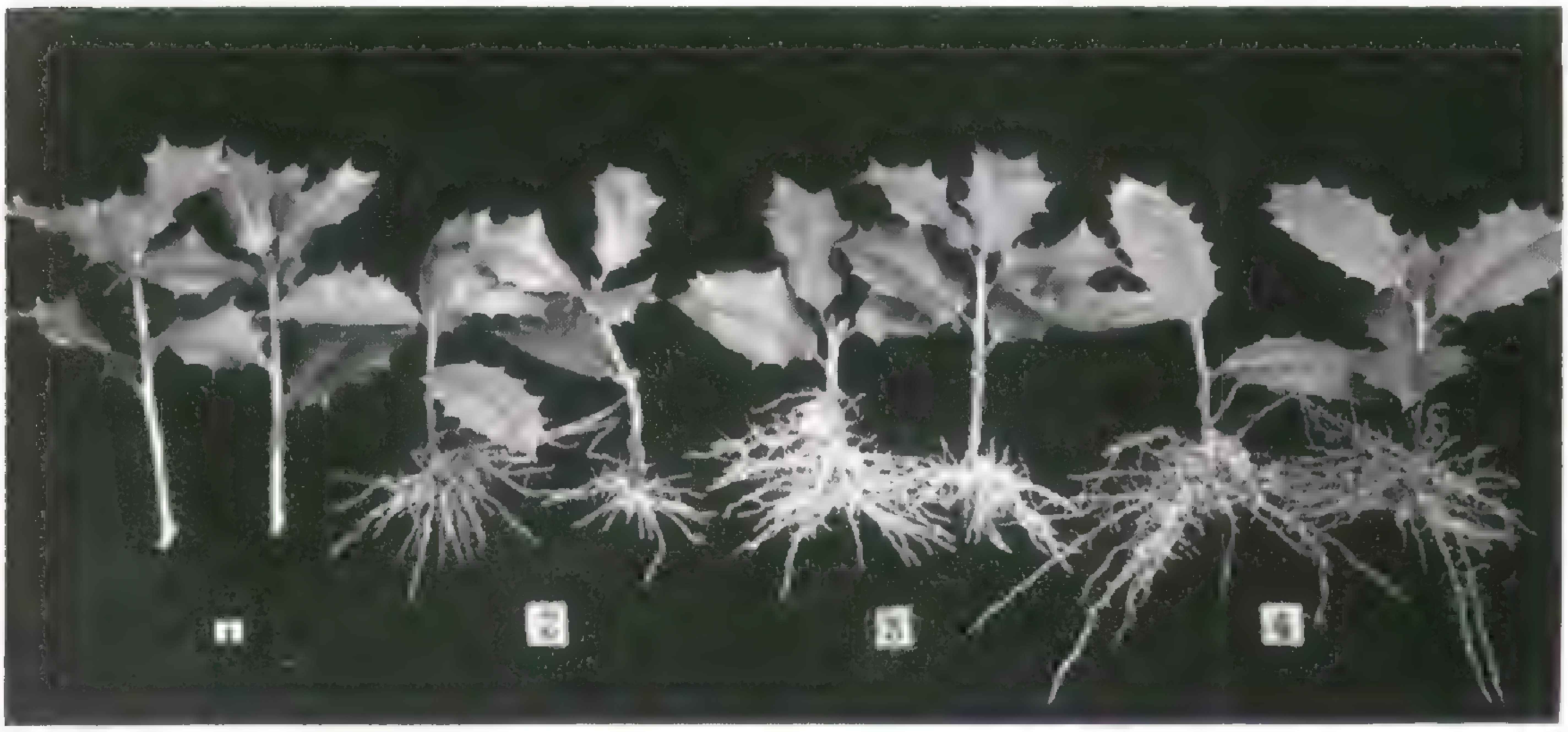

Fig. 10. Holly cuttings, all from the same tree, after 60 days in the rooting medium: 1—untreated; 2—dipped in Rootone #10; 3—dipped in Hormodin #3; 4—24 hours in Hormodin A solution.

PROPAGATING THE AMERICAN HOLLY

Holly berries may be gathered in the fall and placed in a jar of water for one or two weeks to soften the pulp by fermentation. The seeds are then easily separated from the pulp by rubbing them over a wire screen and frequently flushing with water. They are then spread on paper and when dry put in sacks or placed between layers of sand in a box for stratification outdoors. The following spring the seeds may be sown in a prepared frame, or in flats or pots. Pots and boxes should always be covered with screening to keep out rodents. No seedlings will appear the first year, but by the second spring most of the seeds will have germinated. Seedlings are transplanted to flats and a year later are planted into 2½- or 3-inch pots or

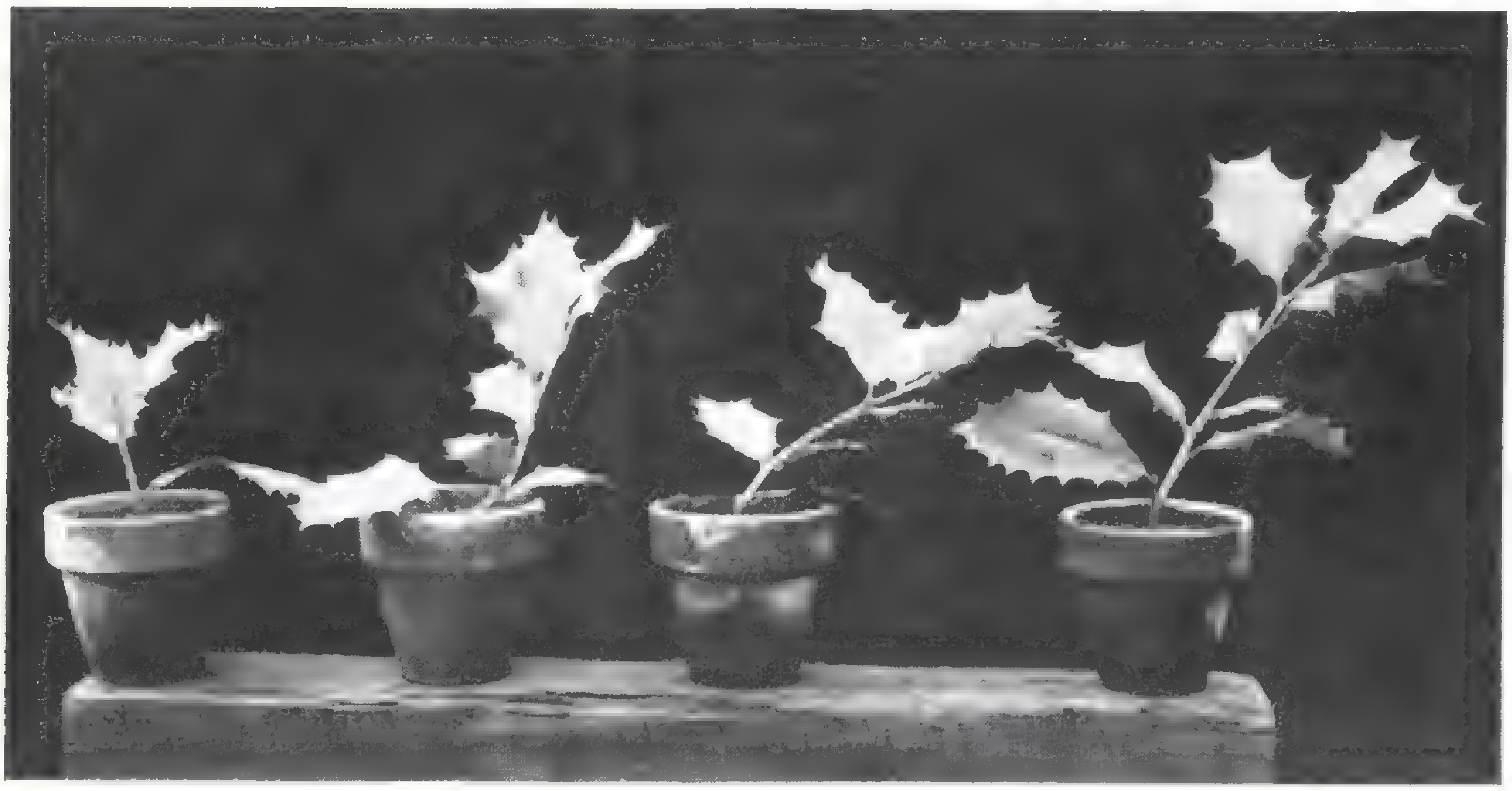

Fig. 11. Two- and three-eye leaf cuttings

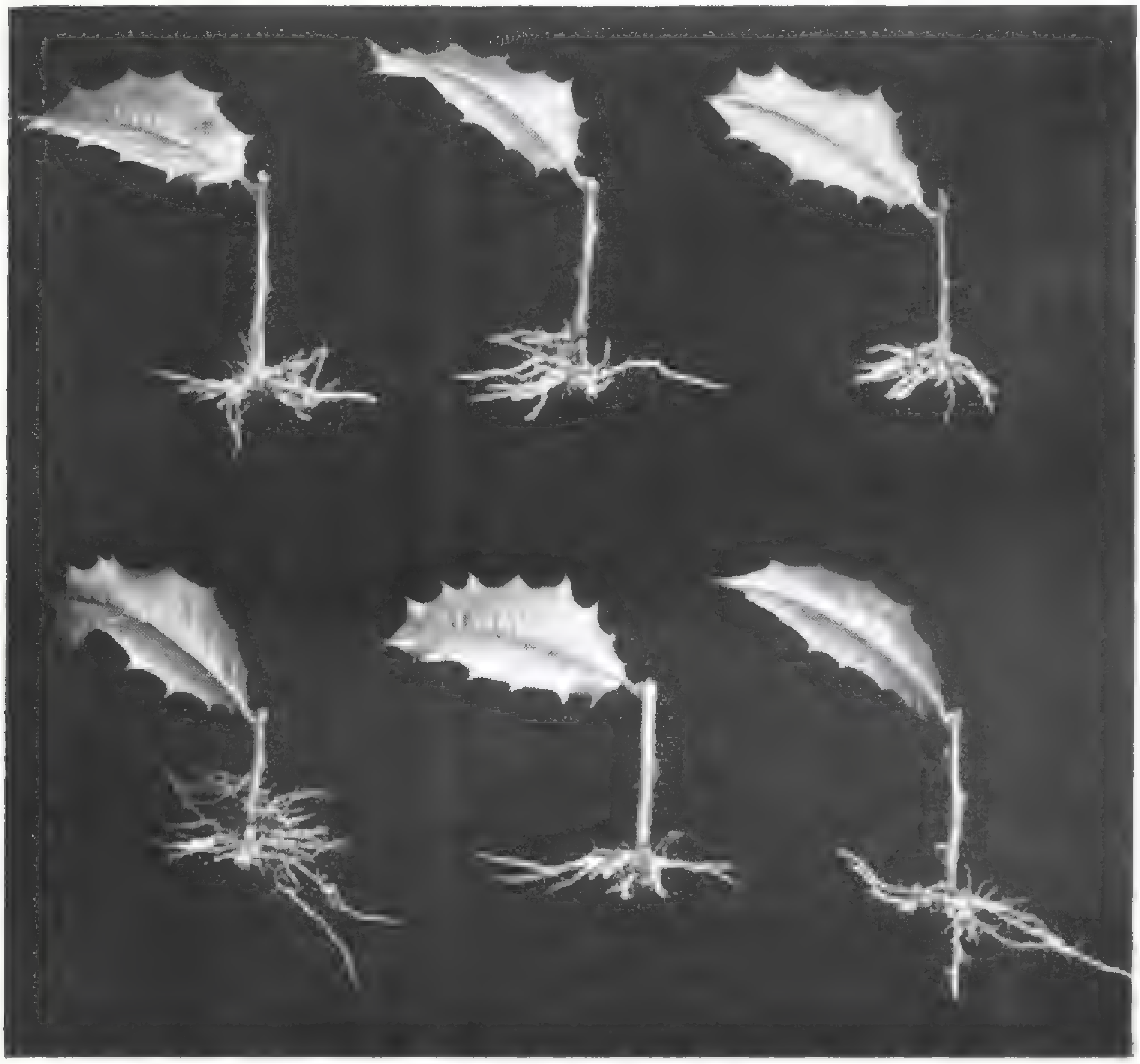

Fig. 12. Leaf cuttings five months old

directly into a frame. Hollies are easily grown from seed, but it takes time and one must wait almost ten years before it is possible to select the berried plants.

With growth-inducing substances in liquid and powder form it is now possible to root hollies in about two months, whereas it requires about twenty months to get a start from seed. Cuttings may be made from October to January, and from our experience during a three-year period we consider late November and early December about the best time. Cutting-wood that has been exposed to several degrees of frost is fully ripened and new growth will develop soon after the plants are potted in January and February. Cuttings are usually made from the tips of branches, three to six inches long, each with three to four leaves. Sand is a fairly good rooting medium, but better results are obtained from a mixture of two-thirds sand and one-third peat moss. After dipping cuttings in one of the hormone powders, insert them in the rooting medium, using a dibble. If they are

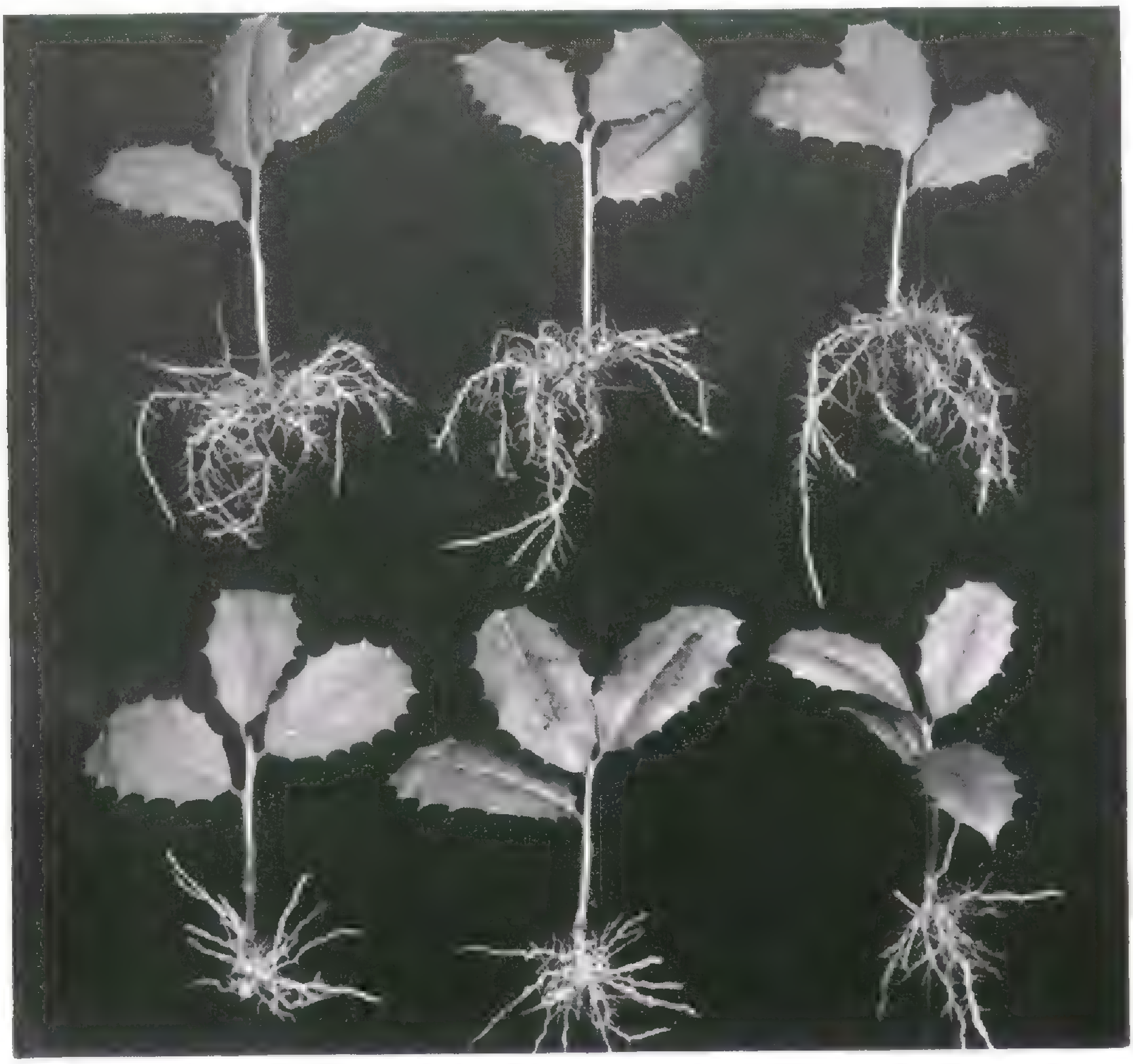

Fig. 13. Holly cuttings rooted after 70 days: upper row in peat moss-sand medium; lower row, in sand.

placed in a slanting position instead of being set upright in the medium, the leaves are brought closer to the surface of the cutting bench and transpiration is reduced. During the first few weeks the cuttings should be shaded on bright days. At least four syringings each day will prevent the leaves from dropping, an important point to remember, for a cutting without leaves will not root. Figure 10 shows how well cuttings will root when they are dipped in growth-inducing substances as compared with those left untreated. Liquid hormone preparations induce even more and longer roots than powders (fig. 10, No. 4), but since holly cuttings root so well in eight weeks by the powder-dip method, very little is gained by using the solution. It is a very simple operation to moisten the base of the cutting, dip it into the powder and immediately insert it in the bench. For best results in rooting, the temperature of the cutting bench should always be maintained between 65 and 70 degrees.

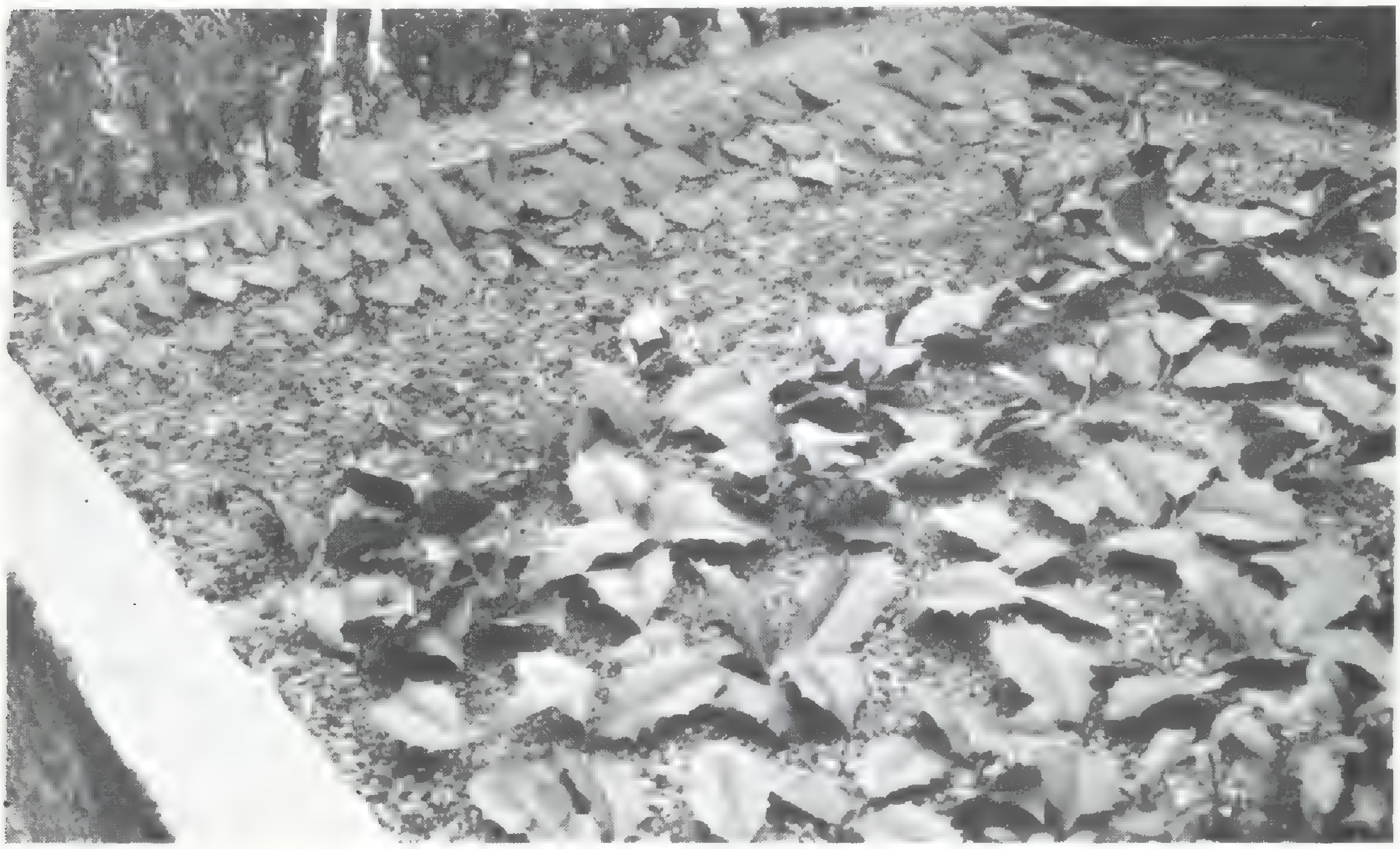

Fig. 14. Single leaf and regular holly cuttings

It is possible to propagate many plants from a small amount of cutting-wood by making single leaf cuttings with one or two buds on each stem. The cuttings are quite short, as can be seen in fig. 14, but fig. 12 shows that the length of growth from single leaf cuttings, five months after being potted, compares favorably with those made from the tips of branches.

It pays to keep the lawn raked in November. Blue grass grows rapidly then, and it is not happy under a mulch of rotting leaves.

SOME ADDITIONAL WORTH-WHILE HOLLIES

A. P. BEILMANN

Aside from the American Holly *(Ilex opaca)*, which is grown in many of our gardens, hollies are not widely used in this area. The genus contains plants of all sizes, from shrubs to trees, deciduous and evergreen, and all withstand shearing and shaping. Some of these are of questionable hardiness, but even though they freeze to the ground in severe winters their foliage is so good that they should find a place in our gardens.

The English Holly *(Ilex Aquifolium)* has a number of cultivated forms, all having waxy leaves with very wavy margins and large spiny teeth. They are not likely to attain a great size in our climate, but their foliage is so striking that they should be grown even though they freeze occasionally.

Chinese Holly *(Ilex cornuta)* and its variety, *Burfordii*, are not likely to outgrow their place in the garden since they are reported more tender than the English Holly. However, we have grown them at the Arboretum for three years in full exposure without their being even a bit damaged. They look very promising, and the unusual rectangular leaves with three spines at the tips, which is characteristic of the species, make the foliage of considerable interest. The leaves of the variety *Burfordii* are tipped with only one spine and are the finest, most glossy and waxy of any holly that we can grow. It differs so much from the species that it might be considered an entirely different plant. Certainly, its use as an ornamental would be quite different.

The Japanese Holly *(Ilex crenata)* looks very much like Boxwood and might easily be confused with that plant as well as substituted for it in the garden. All the varieties of this species are small, much-branched shrubs. They are perfectly hardy and entirely at home in the Middle West. They flower in early spring at the same time as the American Holly and produce a great number of tiny white flowers. The varieties *latifolia* and *microphylla* have leaves that are very small, about twice as long as that of Boxwood, lustrous green, and finely serrated. Both of them are almost without a bad habit and would make excellent hedge plants.

As you drive through Missouri in the fall note the dense stands of short, upright plants on gravel banks and roadsides where nothing else will grow. These are the famous Japanese and Korean Lespedezas, two little annuals which man inadvertently introduced into the Ozarks as if to pay the country back for some of the damage he had done. They make an excellent ground cover, they add nitrogen to the soil, and their nutritious little seeds are an important food for quail.

A NEW HARDY BAMBOO FOR ST. LOUIS

G. H. PRING

Five small plants of a bamboo (labelled *Phyllostachys nevinii*, but later described as *P. aureosulcata*) were received at the Garden from the U. S. Department of Agriculture, Division of Plant Introduction, in April, 1932. They were immediately planted at the south end of the lotus pool west of the Aroid House. This location seemed to be ideal, as evidenced by the fact that the five little plants have now grown into a massive clump of canes seven to eight feet high and each cane of finger-width thickness. When first planted the plants would freeze to the ground every winter but now with good root formation the stronger canes are able to withstand zero temperatures. At the first freeze the foliage turns brown, then falls off, leaving the canes bare until early spring. Few bamboos planted in this area have ever produced the lush tropical effect of this species during the spring and summer months.

Phyllostachys aureosulcata at the Garden

This bamboo was introduced into this country from China in 1908 by Mr. Frank N. Meyer, plant collector for the U. S. Department of Agriculture, Division of Plant Exploration and Introduction, and a former member of the Garden staff. For some years it was carried under the name *Phyllostachys nevinii.* Dr. F. A. McClure, bamboo specialist of the Department of Agriculture, suspecting that it had been incorrectly identified, compared the herbarium type specimen of *P. nevinii* deposited at the Kew Gardens, England, with the introduced material. His conclusion was that the two represented entirely distinct species, and this view was supported by the fact that the new bamboo had not been discovered anywhere near the type locality of *P. nevinii* during many years of diligent search. In 1945 Dr. McClure described it as a new species[1], *Phyllostachys aureosulcata*, the specific name, meaning "with golden furrows," in allusion to the distinctive colored furrows of young stems and their branches.

LIVING ON THE ORIGINAL BRANCH IN A GREENHOUSE FOR TEN YEARS

Oncidium stipitatum

G. H. PRING

Visitors frequently ask: "How long will an orchid last under cultivation?" In the September Garden BULLETIN the writer mentions *Paphiopedilum Rothschildianum* in the collection since 1904.

Observations in the Tropics show that epiphytic orchids will soon perish after the tree dies, the plants falling to the ground with the loosened bark. Several large specimens of *Cattleya Trianae*, collected in Colombia in 1923, were grown on Missouri logs with the help of attached peat. The plants flowered annually for several years, and were exhibited in the Floral Display House.

During 1937, while in Panama, I collected several large specimens of *Oncidium stipitatum* with pendent stiletto-shaped leaves 18 inches long. One small upright specimen was struggling for existence on a one-inch extended twig, a Tillandsia plant growing in with it. The twig with the two attached plants was carefully packed and shipped to the Garden where it was hung up in the South Pit House. For the past ten years the orchid has grown and flowered annually with no attention but a daily sprinkling of water. Attached to the original twig are seventeen small pseudobulbs, of which six are alive on the growing end, three carrying leaves. The annual growth has been in spiral formation, and at the base the little rosette Tillandsia was still growing until last year, when it finally succumbed. For the past ten years the orchid has not increased in size, its leaves averaging only 5 or 6 inches in length. Since it is making its new growth it now deserves some assistance so it will be planted in peat in a basket. There it will have opportunity to grow pendent-fashion and to develop into a plant like the others collected at the same time. Eventually it should have leaves 18 inches long and flower spikes carrying forty or fifty "Dancing Girl" flowers.

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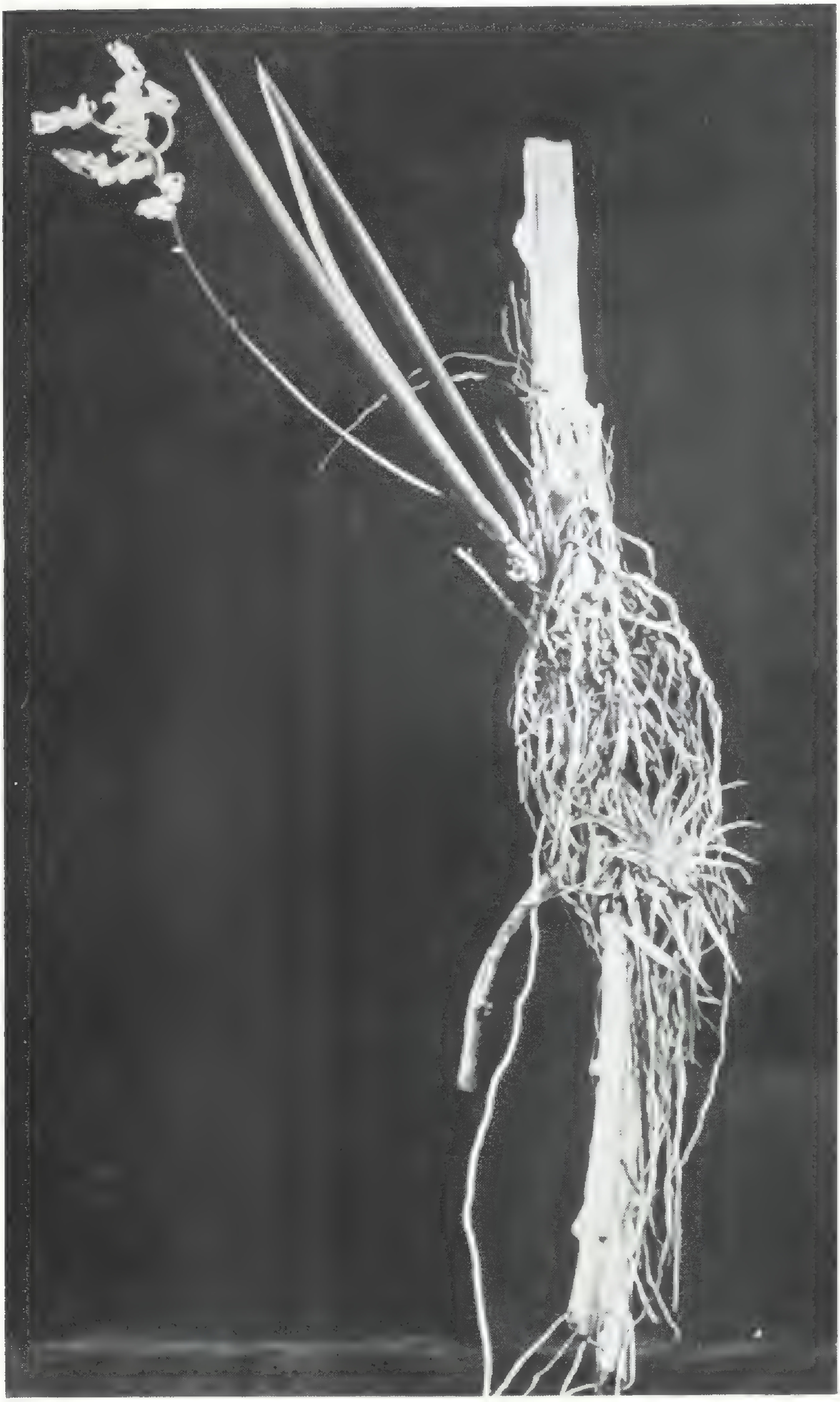
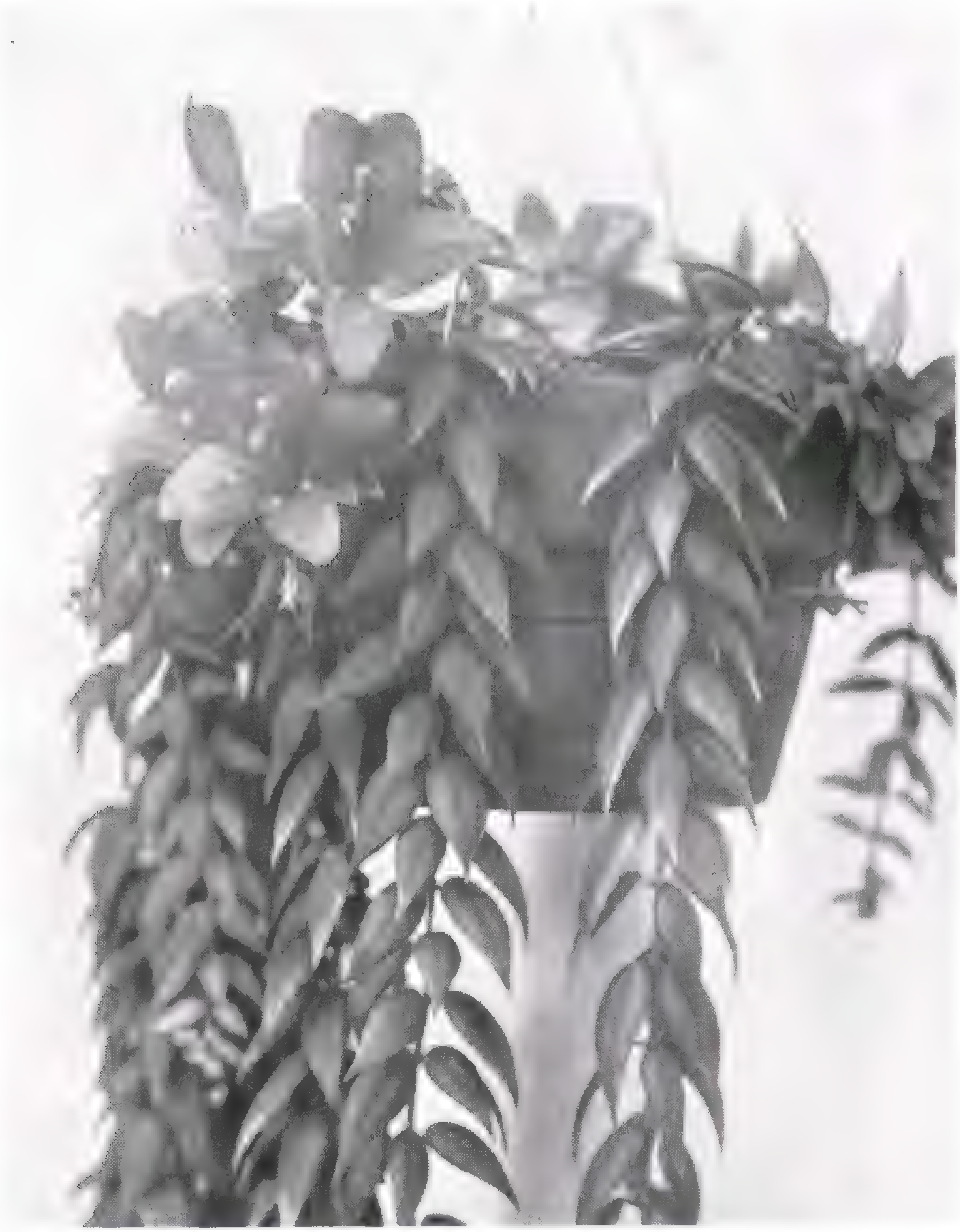
[1] Jour. Wash. Acad. Sci. 35:284.



Oncidium stipitatum living on the original twig in a greenhouse for ten years



Columnea Allenii

A NEW GREENHOUSE PLANT

(COLUMNEA ALLENII)

G. H. PRING

In June, 1940, Mr. Paul H. Allen, the Garden's Tropical Representative, found a plant in the hills of Panama which was later described as a new species, *Columnea Allenii*, by C. V. Morton (in Ann. Mo. Bot. Gard. 29:42. 1942). In September, 1946, Mr. Allen sent to the Garden by air-mail five small cuttings of the plant. As soon as they arrived they were taken to the orchid houses at Gray Summit. There they were rooted in a mixture of finely chopped peat, sphagnum moss, and sand, placed in a Wardian case which is also used for rooting pitcher plants (Nepenthes). Already growing in this greenhouse were three pubescent-leaved species of Columnea that were proving somewhat difficult to culture, resenting change of temperature, particularly a lower water temperature than that of the house. The new smooth-leaved species does not seem to be so temperamental, since within a year the young rooted cuttings have developed into a specimen with pendent showy flowers and leafy stems two feet long. It is by far the best-growing Columnea that we have ever encountered and could be recommended as a greenhouse plant.

Description.—The genus belongs to the family Gesneriaceae, to which Gloxinia and Saintpaulia (African Violet) also belong. The flowers are a brilliant scarlet. The corolla tube is about 1½ inches high, hairy, balloon-shaped, flaring out at the top into four lobes. The middle upper lobe is cleft, and the two side ones have an orange-yellow area on the inside (see illustration). The four stamens are bright yellow and bend forward at the top, bringing the anthers in position for insect pollination. The stigma is bi-forked and also bends forward. In the bud stage the sepals show five rows of purplish-red spine-like ridges, and when the bud opens these ridges form the deeply cleft margins of the calyx lobes. To the horticulturist this is a mark of distinction in the species. The leafy stems are 1–2 feet long and hairy. The leaves are either in pairs or clusters, ovate-lanceolate, acuminate, glabrous, dark green above, lighter below, with hairy petioles.

A NATIVE OXALIS AS A FOLIAGE PLANT FOR MISSOURI GARDENS

JULIAN A. STEYERMARK[1]

Most of us who have enjoyed the decorative value of various cultivated species of Oxalis with their three-foliolate leaves and usually rose-red or yellow flowers are probably unaware of the fine qualities of some of our own Missouri species. Although the native Yellow Wood Sorrels are generally looked upon as weeds (especially O. *stricta* and O. *corniculata*) there are some members of the genus which are non-weedy and have unusual colorful foliage. As cultivated garden subjects they deserve recognition by horticulturists in the Middle West. Such plants are *Oxalis europaea* and one of its forms, O. *europaea* var. *Bushii* forma *vestita.*

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[1] Assistant Curator of the Herbarium, Chicago (Field) Museum of Natural History, and author of "Spring Flora of Missouri."

Both *Oxalis europaea* and its form are found growing throughout the Ozark region, generally in rocky open woodlands, on bluffs or wooded slopes, or on level ground. They are conspicuous for their purplish-tinged or copper-purple leaves, unlike other forms and varieties of the species which have olive-green or grass-green foliage. Although they are generally found as single individuals growing wild in the forest, it can easily be imagined what a striking color effect might be produced by a mass display. The plants are perennials and favor moist locations apparently in neutral or limey soil.

Seldom has the fall coloring extended over such a long period as in 1947. Some trees were affected by the summer drought and colored prematurely. The lack of frost and the warm weather of October kept others from changing as early as they often do, and early November finds us with a strange mixture of red-brown oaks and maples still in leaf.

ANNUAL COURSE IN HORTICULTURE FOR AMATEURS

A course in horticulture for amateurs, designed to acquaint the participants with principles and practices of gardening, with particular reference to the culture of herbaceous plants, will be given from February 11 to May 5, 1948. The classes will be held in the experimental greenhouse on *Wednesdays* from 9:00 to 12:00 a. m. The course will be in charge of Dr. Mehlquist.

REGISTRATION: As it is necessary to limit the class to 25 persons, it is desirable that registration be made by letter, with check enclosed payable to the Missouri Botanical Garden, as soon after January 1 as possible. Tickets will be distributed at the experimental greenhouse on day of first lecture.

FEE: The registration fee is $15.00 per student, and tickets are not transferable.

SUBJECT MATTER OF THE COURSE

I. Fundamentals of plant growth.
    - The role played by light, temperature, water and air.
    - The soil and associated materials.
    - Mineral nutrition.

II. Practical points in successful gardening.
    - Choice of location and soil; preparation and improvement of soil.
    - The nature and use of fertilizers.
    - Practical plant propagation: seed sowing, cuttings, and division.
    - Potting and transplanting of seedlings and cuttings.
    - Planting and handling of bulbous plants for forcing during winter.
    - Selection and general care of house plants.
    - Identification and control of common garden pests and diseases.
    - Landscaping the home grounds; design, choice of suitable plants and their care.
    - Preparation and care of lawns.
    - Demonstration of various phases of garden work.

(About ¼ of the time will be devoted to theoretical discussions outlined in Section I; the remainder of the time will be devoted to subjects of Section II.)

EARLY ACCOUNT OF CHEMICAL TREATMENT FOR TREES

While long regarded as impracticable, if not useless, the use of various chemicals applied to the roots, or injected into trees as a remedy for certain diseases is gradually being recognized as at least being worthy of further experiment. Since a start is now being made towards an attempt to control plant diseases by chemotherapy the following note which appeared in the *American Journal of Science and Arts* for October, 1825, is of some historical interest. Apparently there was no question in the mind of the writer as to the efficacy of the treatment.

> 6. RECIPE FOR DRIVING INSECTS FROM TREES—communicated.—Bore a hole into the trunk of the tree, as far as, or into, the heart, fill this hole with sulphur, and place in it a well fitted plug. A tree of from four to eight inches in diameter requires a hole large enough to admit the little finger, and in the same proportion for other and larger or smaller trees. This will usually drive the insects away in the course of forty-eight hours, but uniformly succeeds, perhaps sometimes after a longer time. These facts were mentioned to me by the Rev. Dr. Woodhull. He stated that a fine large shade tree in Albany, was so infested with worms and caterpillars that passers by were obliged to make a circuit to avoid it; it became so much of a nuisance that they were on the point of cutting it down, when the application of this experiment in forty-eight hours entirely cleared it of the insects. Col. Rutgers of New York has tried this experiment with (I think) uniform success; and in several instances, fruit-trees which were almost lifeless were restored.

NOTES

Mr. George H. Pring, Superintendent of the Garden, conducted the plant clinic at the meeting of the St. Louis Horticultural Society, October 3.

The present enrollment of twenty graduate students in the Henry Shaw School of Botany is the largest in its history. Among them is a graduate of the University of Rangoon, Burma, and one from the Royal Institute of Science, Bombay, India.

Dr. Carroll W. Dodge, Mycologist to the Garden, served as chairman of the section on General Mycology at the Conference on Medical Mycology organized by the New York Academy of Sciences on October 31 and November 1. He presented the opening address on "Mycological Research and the Progress of Medicine."

Recent visitors to the Garden include: Mr. Rune M. L. Mehlquist, Eskistuna, Sweden; Mr. Piero Grossi, of Florence, Italy; Mr. Walter Nijhoff, of the firm of Martinus Nijhoff, Publishers and Bookdealers, of The Hague, Netherlands, who is responsible for the Garden having an almost complete set of the European botanical periodicals published during the war years;

Mr. Raymond M. Alsina, Architect, of Buenos Aires, Argentina; Dr. Charles B. Heiser, Assistant Professor of Botany, University of Indiana, Bloomington; Dr. Antonio Marino A., Agronomist, Secretaria de Agricultura y Fomento, Mexico.

The 1947 Chrysanthemum Show, which opened on November 9, promises to be one of the best in recent years. A year ago the bush varieties in the nursery were severely damaged by the hail storm, and only a small number of plants could be used. In most seasons, the tarnished plant bug is the cause of many crippled flower buds, but this year the plants are well set with buds. This is the result of spraying with DDT, and if the use of the spray is as successful in succeeding years chrysanthemum growers will have one less problem to solve in the production of quality stock.

On November 8 an informal round-table conference was held at the Garden to consider a number of problems connected with the classification and history of Indian Corn. An ear of corn is one of the most complicated structures in the entire plant kingdom; recent work at the Garden and elsewhere has made the problem even more difficult by demonstrating how many kinds of maize there are and how fundamentally different is the structure of the ear in some of these kinds. Those who came to the conference have all been working on one phase or another of this general problem. In addition to Dr. Van Schaak, Dr. Anderson, and Mr. Jonathan Sauer, at the Garden, the following took part: Dr. Henri Prat, University of Montreal; Dr. Paul C. Mangelsdorf, Harvard University; Dr. Hugh C. Cutler, Chicago Museum of Natural History; Dr. Richard Laubengayer, Wabash College; Dr. O. T. Bonnet, University of Illinois; Dr. Paul Weatherwax, University of Indiana; Dr. William L. Brown, Pioneer Hi-Bred Corn Company, Johnston, Iowa; Dr. L. J. Stadler, University of Missouri. It is planned to publish some of the results of the conference in a special number of the ANNALS.

The Chittimwood, *Bumelia lanuginosa,* a common but little-known tree of the Ozark highlands, bears fruit very rarely in the St. Louis area. This year its dark blue berries are a common sight at the Arboretum at Gray Summit. While these little berries are not relished by human beings they are most attractive to birds. A flock of Cedar Waxwings was seen feeding in one of the trees at the Arboretum, cleaning out a good half of the crop at one meal.

THE MISSOURI BOTANICAL GARDEN

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

MISSOURI BOTANICAL GARDEN BULLETIN

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POLYPLOIDY IN THE GENUS PAPHIOPEDILUM PFITZ. (CYPRIPEDIUM HORT.), AND ITS PRACTICAL IMPLICATIONS

GUSTAV A. L. MEHLQUIST

Since the production of the first Paphiopedilum hybrid *(P. Harrisianum = P. barbatum × P. villosum)* in 1869 probably more crosses have been made or attempted in this genus than with any other orchid, yet the actual number of plants raised from seed is undoubtedly much smaller in this genus than in Cattleya and related genera. One reason for this difference is probably the fact that crosses among species and hybrids of Paphiopedilum are usually much more difficult to make than in the Cattleya group, and very likely as a consequence of this, seed production per cross is usually rather low. Furthermore, the seeds of Paphiopedilum often germinate much more irregularly than others; sometimes they keep germinating for a period of months or even years. As it is difficult to maintain favorable conditions for germination of orchid seeds for a long time many seeds that could germinate probably never do so.

These difficulties may be due to the fact that the species of Paphiopedilum differ more genetically than those in Cattleya in which all the large-flowered species have at one time or another been regarded as forms of one species, or that Paphiopedilum may possess some seed dormancy mechanism, as yet poorly understood, so that only rarely by accident or otherwise are the proper conditions provided for the germination of the seeds. However, neither of these assumptions provides an explanation why, by and large, crossability, seed production, and seed germinability decrease as horticulturally more desirable forms are used as parents. In other words, the choicer the plant selected for parenthood, the less likelihood, apparently, of raising an appreciable number of seedlings and, often also, the choicer the parent the greater the variability of the seedlings. A comparison of the vegetative characteristics of our large-flowered hybrids with the species that have given rise to them offers a definite clue.

Compared to the ancestral species, many of the most outstanding present-day hybrids are distinguished by having larger and thicker leaves and larger and rounder flowers of heavy texture. In other plant families which have been studied cytologically such differences have been found to be due to an increase in chromosome numbers. In other words, they have been polyploids.[1]

During the past summer I spent three months in England for the purpose of gathering data for a projected study of genetical and cytological aspects of orchid breeding. After a preliminary survey it was apparent that most could be accomplished in the short time available by concentrating on one or two genera. As Cymbidium and Paphiopedilum responded best to available cytological procedures, most of the time was spent on them. This article will record the data obtained to date relative to polyploidy in Paphiopedilum, while the genus Cymbidium will be dealt with later. Although the information available is admittedly incomplete it has been deemed advisable to summarize it at this time partly because it presents some light on the problems confronting orchid growers and partly because it might enable other investigators to select certain phases of the problem for further studies. At least two commercial growers in this country are already supporting cytological research in this genus in order to get the answer to some of the problems encountered, and others, both in England and in this country, have indicated their intention to do so.

All the chromosome counts were made on root-tip smears. Several killing and fixing fluids were tried but the best results were eventually obtained by using a modification of Carnoy's fluid: 6 parts 100 per cent ethyl alcohol, 3 parts chloroform and one part glacial acetic acid saturated with carmine. The tips were quartered and left in the fixing fluid from 1 to 72 hours and then smeared and stained in lacmoid (as explained in the following paper). Most of the determinations were made in England on material kindly furnished by the growers mentioned below. Some of the counts have been made on material from the Missouri Botanical Garden. The chromosome numbers of the species that are of interest in this discussion are given in table I, and those of the hybrids investigated in table II. In addition, root tips were collected from nearly 100 advanced hybrids of the

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[1] Haploid = one set of chromosomes.
Diploid = two sets of chromosomes (normal condition for most plants).
Triploid = three sets of chromosomes.
Tetraploid = four sets of chromosomes.
Pentaploid = five sets of chromosomes.
Hexaploid = six sets of chromosomes.
Octoploid = eight sets of chromosomes.
Polyploid = many sets of chromosomes (usually applied to triploids and higher conditions).

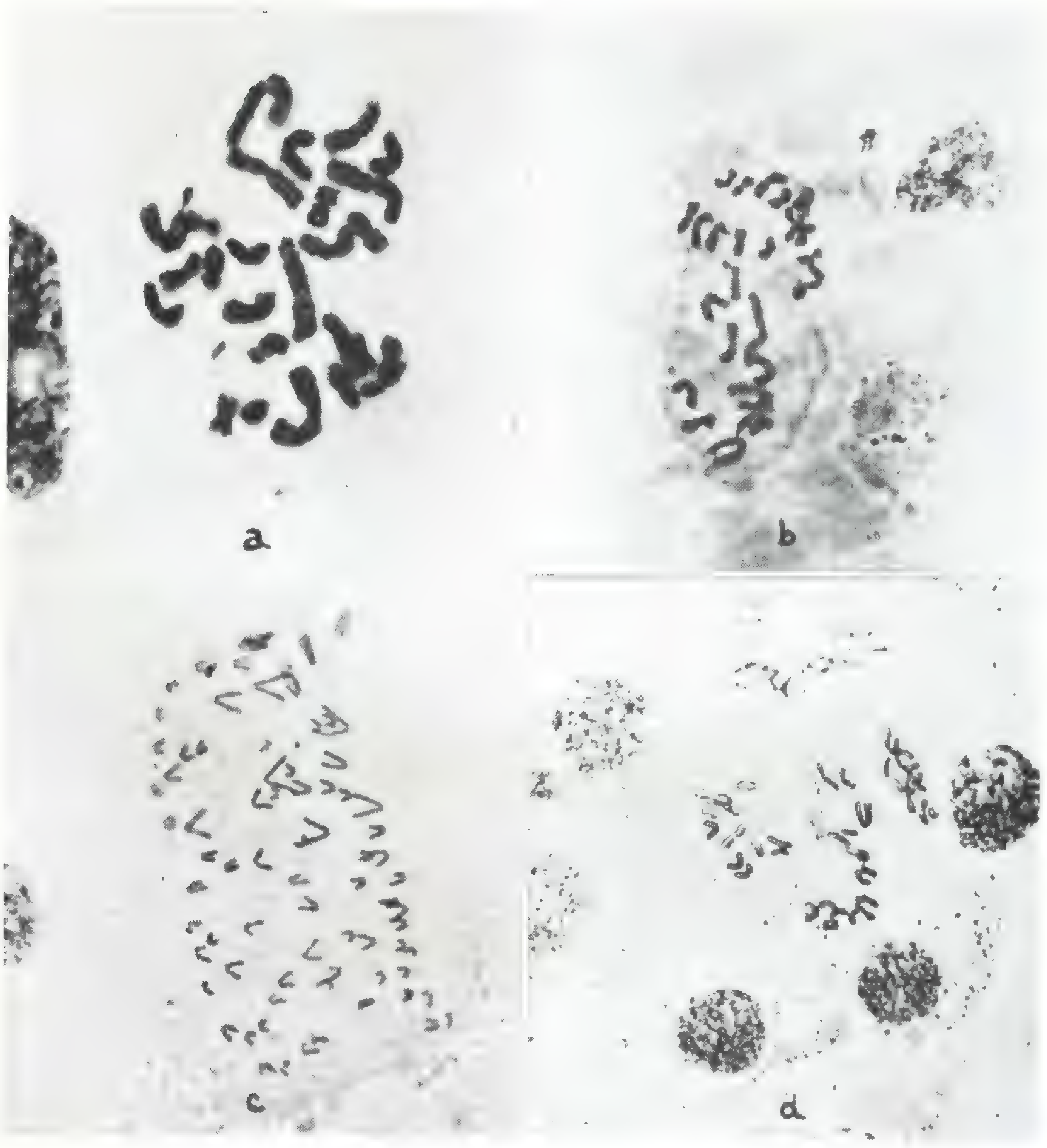

Fig. 1: a, *Paphiopedilum insigne*, 26 chromosomes, enlarged about 1500 times; b, *P. insigne* var. *Sanderae*, 26 chromosomes, enlarged about 800 times; c, *P. i.* var. Harefield Hall, anaphase showing 78 chromosomes, 39 going to each pole, enlarged about 800 times; d, × *P.* Goliath, 39 chromosomes, enlarged about 500 times.

insigne group, that is, hybrids having in their ancestry mainly *P. Boxallii, insigne, Spicerianum,* and *villosum.* Owing to the fact that many of these tips were not in good condition and many were taken before good staining schedules had been worked out, trustworthy counts were obtained only for 62 plants. Of these, there were 23 with 26 chromosomes, 3 with 27, 8 with 39, 2 with 40, 2 with 41, 17 with 52, 3 with 53, and 4 with 54.

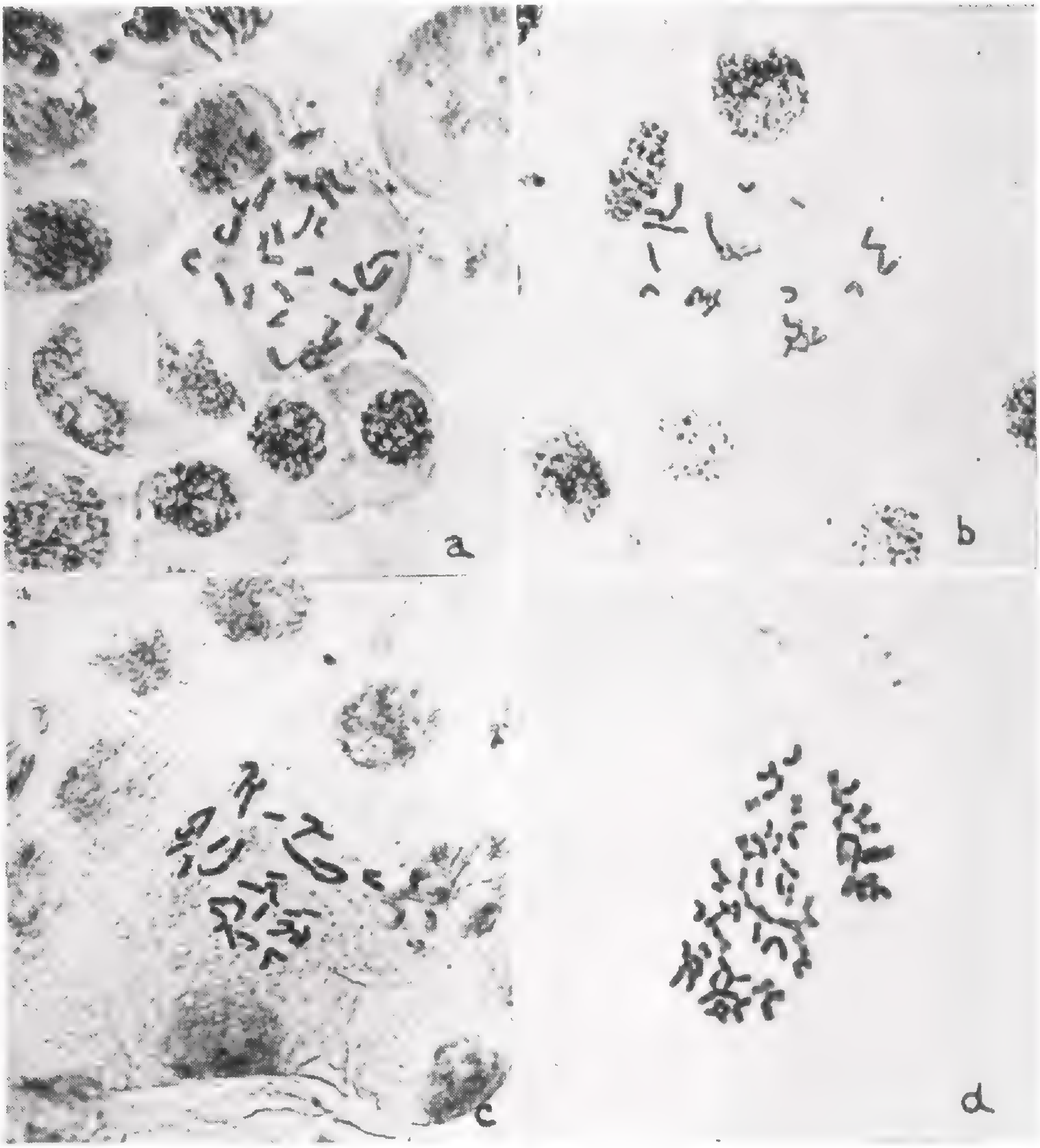

Fig. 2: a, *Paphiopedilum Boxallii*, 26 chromosomes; b, × *P. Leeanum* var. *aureum*, 28 chromosomes; c, × *P. Harrisianum* var. *nigrum*, 32 chromosomes; d, × *P.* TEARLATH, 52 chromosomes.—All enlarged about 500 times.

As may be seen from table I and figs. 1 and 2, a diploid number of 26 is the rule for the *insigne* group of species, the only exception being the HAREFIELD HALL variety of *insigne* (pictured on cover page) which has 39 chromosomes. The basic set of chromosomes then for this group is 13 and *insigne* var. HAREFIELD HALL is a triploid. Since polyploids often have a number which deviates slightly from an exact multiple of the basic set, the plants with 40 and 41 chromosomes can still be considered triploids and those with from 52 to 54 chromosomes as tetraploids. The relative proportions of 26 diploids, 12 triploids, 24 tetraploids must not be regarded as representative of the groups from which they were chosen, since root tips were taken only from plants selected to include all visibly different foliage types, there being no flowers on the plants at that time. In general, the plants that eventually proved to be triploid or tetraploid had somewhat larger and thicker leaves than the diploids, and later, when a few of the plants could be seen in bloom, it was evident that the same relationship held for the flowers; that is, the flowers on the triploids and tetraploids were generally larger and of a heavier texture than those on the diploids. This difference is particularly striking in *P. insigne* var. HAREFIELD HALL which, when well grown, is much larger both in flower and foliage than all other forms of *P. insigne* that I have seen. In discussing this point with some of the growers from whose plants root tips were taken, I was told that some years back there had been several forms as large as the HAREFIELD HALL variety. However, the only forms of *P. insigne* that were similar to HAREFIELD HALL, namely *P. insigne* var. *giganteum*, *P. i.* BARON SCHRÖDER, and *P. i.* FRANCIS WELLESLEY, were all eventually declared identical with the HAREFIELD HALL variety (Orchid Rev. vol. 19, pp. 9–10. 1911). All registrations or references to these names in pedigrees must therefore be considered synonymous with HAREFIELD HALL.

Since the HAREFIELD HALL variety of *P. insigne* was at one time widely used as a parent and must be regarded as at least one likely source so far as polyploidy in the *insigne* group is concerned, its history is of interest. This form was first exhibited at a meeting of the Royal Horticultural Society on December 15, 1896, by Mr. E. Ashworth of Harefield Hall, Wilmslow, Ches., and by Major Mason, the Firs, Warwick, under the name of *Cypripedium insigne giganteum* (Gard. Chron., p. 766. 1896; Orchid Rev. vol. 5, pp. 30–131. 1897). A flower of it sent to *Orchid Review* was accompanied by this description: "An enormous form of this useful old species presumably out of recent importations. The dorsal sepal is over 2¾ inches in diameter and the petals measure 5¾ inches from tip to tip, all the other parts being of corresponding development. In general character it somewhat resembles *C. i. Chantinii.*" (Orchid Rev. vol. 19, pp. 9–10. 1911). On December 13, 1898, when it was again exhibited by Mr. Ashworth, this time under the name of *C. i.* HAREFIELD HALL, it received a First Class Certificate. During the next few years it was shown several times by different people, the name HAREFIELD HALL gradually gaining preference over *C. i. giganteum*. Finally on Dec. 3, 1908, the Manchester Orchid Society formally declared that two other forms of this species, BARON SCHRÖDER and FRANCIS WELLESLEY, were identical with HAREFIELD HALL and should in the future be exhibited under this name (Orchid Rev. vol. 17, p. 23. 1909).

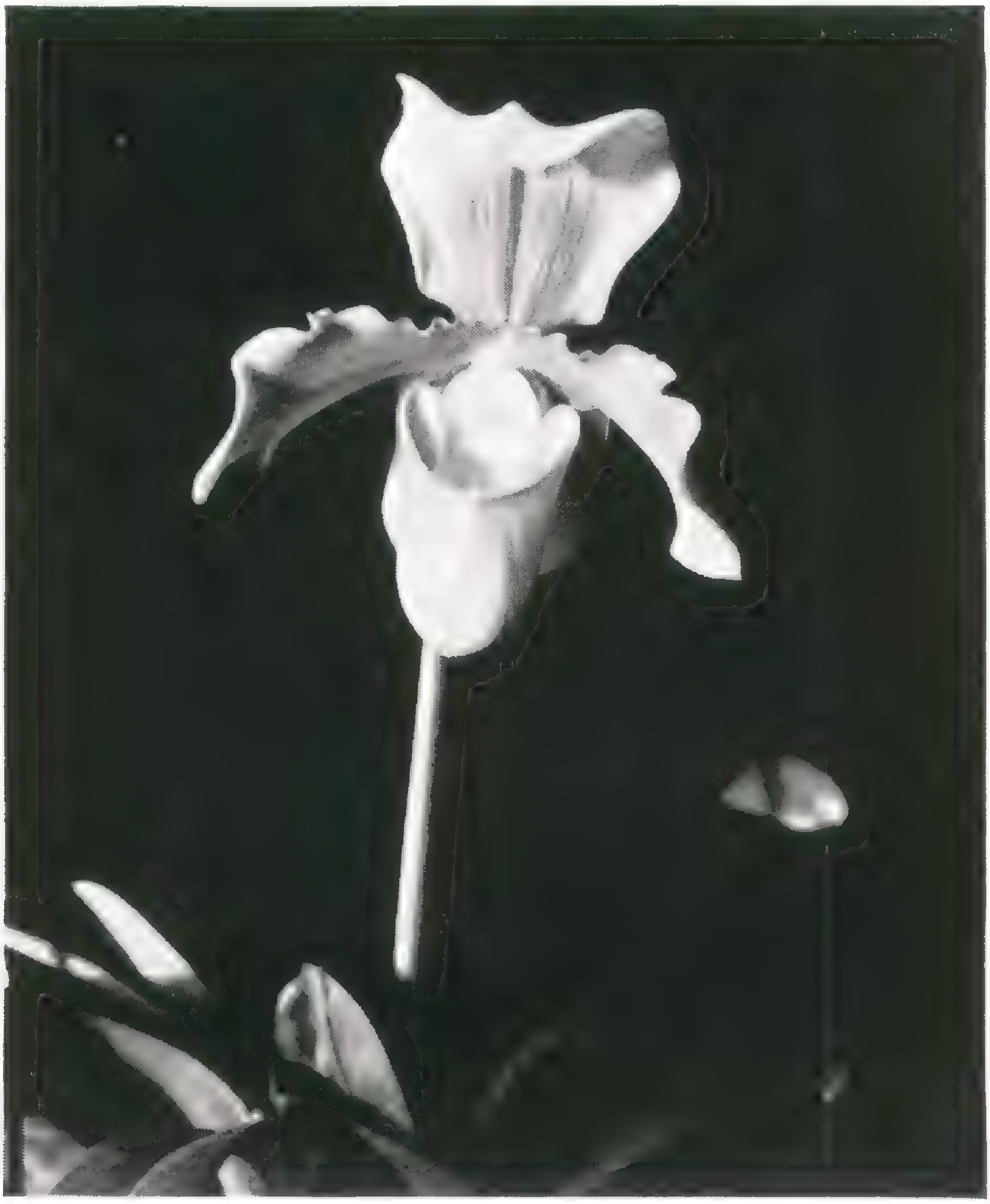

Fig. 3. × P. PAVLOVA (× P. ANITA × *insigne* var. PAVLOVA), 26 chromosomes.

The origin of HAREFIELD HALL does not appear to be known but it is thought to have come into culture with an importation of the so-called *C. i. montanum*. It is stated to have been cultivated by Mr. Ashworth at Harefield Hall since early in 1894 (Orchid Rev. vol. 19, p. 10. 1911). In Sanders' *Orchid Guide* (1927 ed.) its original habitat is given as Assam, which is also the one recorded for the two yellow forms *Sanderae* and *Sanderianum*, whereas *North India* is given for most of the other forms.

The HAREFIELD HALL form of *insigne* was widely used as a parent for many years and if the records of the Royal Horticultural Society Orchid Section (either through Orchid Rev. or the Jour. Roy. Hort. Soc.) are consulted, it is seen that many of its seedlings were given awards by the society. It is described as being quite dominant in its influence on the progeny, especially as regards size. On the other hand, the seedlings from self-pollination of HAREFIELD HALL apparently failed to come up to expectations, for those raised by Mr. H. G. Alexander "reverted to quite ordinary forms" (Orchid Rev. vol. 16, p. 324. 1908). The apparent dominance of HAREFIELD HALL when used in crosses and its poor performance when self-pollinated probably were due to the triploid condition. Meiosis (behavior of the chromosomes in sex cell formation) has not yet been studied in this form, but the appearance of the plant suggests that it is an autotriploid[2]. While triploids generally tend to be sterile, especially when self-pollinated, some will produce a fair number of seedlings most of which are usually diploids or near-diploids. It is quite likely that the seedlings obtained by Mr. Alexander were diploids or nearly so and therefore lacked the size of the parent. On the other hand, when triploids are pollinated by a diploid producing good pollen more seedlings are ordinarily obtained, the majority usually being diploids, with some triploids and occasionally some tetraploids due to non-reduction in the triploid parent. As the good seedlings obtained by using HAREFIELD HALL as a parent were generally described as being "of large size," according to the standards of that day, it is quite likely that some of them were triploids or possibly tetraploids.

Robert E. Duncan, in an account of chromosome numbers in Paphiopedilum (Orchid Digest vol. 11, pp. 199–207. 1947), mentions × *P.* GOLIATH as being triploid (39 chromosomes). A plant of this hybrid in the Missouri Botanical Garden collection is also triploid. It is given in Sanders' *List of Orchid Hybrids* as having as one parent *P. insigne* HAREFIELD HALL, the other being × *P.* TROILUS, AMY MOORE. He also designates × *P.* DRACO var. ATHOLL F.C.C.R.H.S. (× *P.* HERA × *P. insigne*) as tetraploid with 53 chromosomes. I have not been able to find any record of this particular hybrid, so I do not know what form of *P. insigne* was involved. However, the hybrid DRACO was produced in the HAREFIELD HALL era and at least one of its forms, DRACO WESTONBIRT variety, is recorded as having had *P. insigne* var. *giganteum* as one parent (Orchid Rev. vol. 20, p. 26. 1912) which, for reasons already given, is to be regarded as synonymous with HAREFIELD HALL. It is quite likely, then, that HAREFIELD HALL was used as a parent in the variety of DRACO that Duncan reports as tetraploid. At any rate, polyploidy in present-day hybrids must, at least partly, have been derived from the HAREFIELD HALL variety of *P. insigne.*

Another hybrid that has been much used in more recent breeding is *P.* CARDINAL MERCIER (× *P. Lathamianum* × unknown), reported by Dun-

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[2] In autopolyploids the increase in chromosome numbers has been brought about by direct multiplication of the basic set within the species; thus all the sets are identical. In allopolyploids, on the other hand, the sets of chromosomes are not identical but have come from *different* species or widely different forms of the same species.

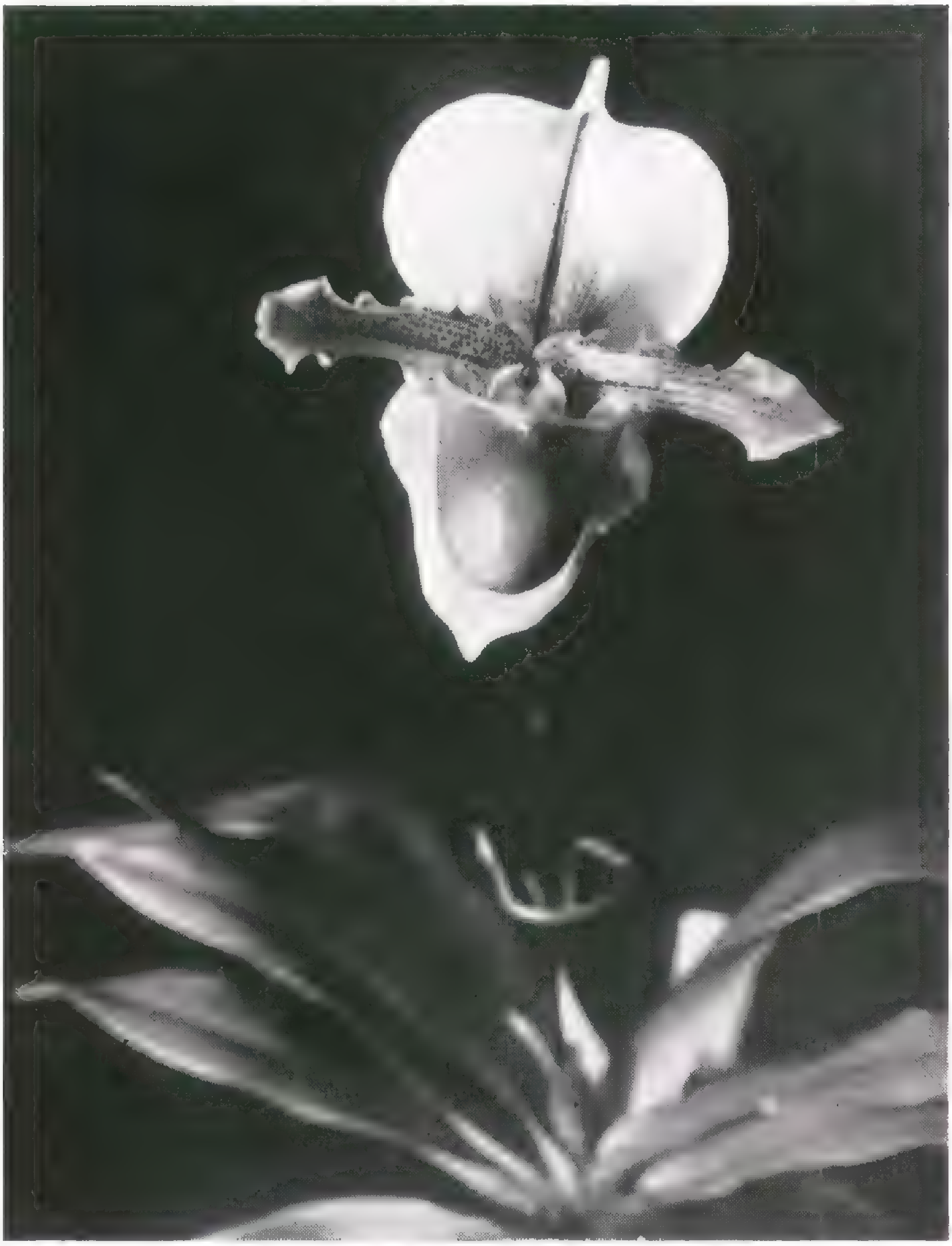

Fig. 4. × *P. Leeanum* var. *aureum* (*P. insigne* × *P. Spicerianum*), 28 chromosomes.

can to be triploid with 39 chromosomes. It has been used as one parent in the cross of *P.* TROJAN, at least one seedling of which in this study was found to be tetraploid (see chart II). The chromosome number of the other parent, × *P.* GERDA, is not yet known.

Of course, non-reduction in gamete formation may occur at any time and thus lead to polyploidy at different points in a breeding program. Such non-reduction, as judged by data from other plants, appears to be rather more successful in producing polyploidy when hybridization is effected between plants of which one or both are relatively sterile interspecific hybrids.

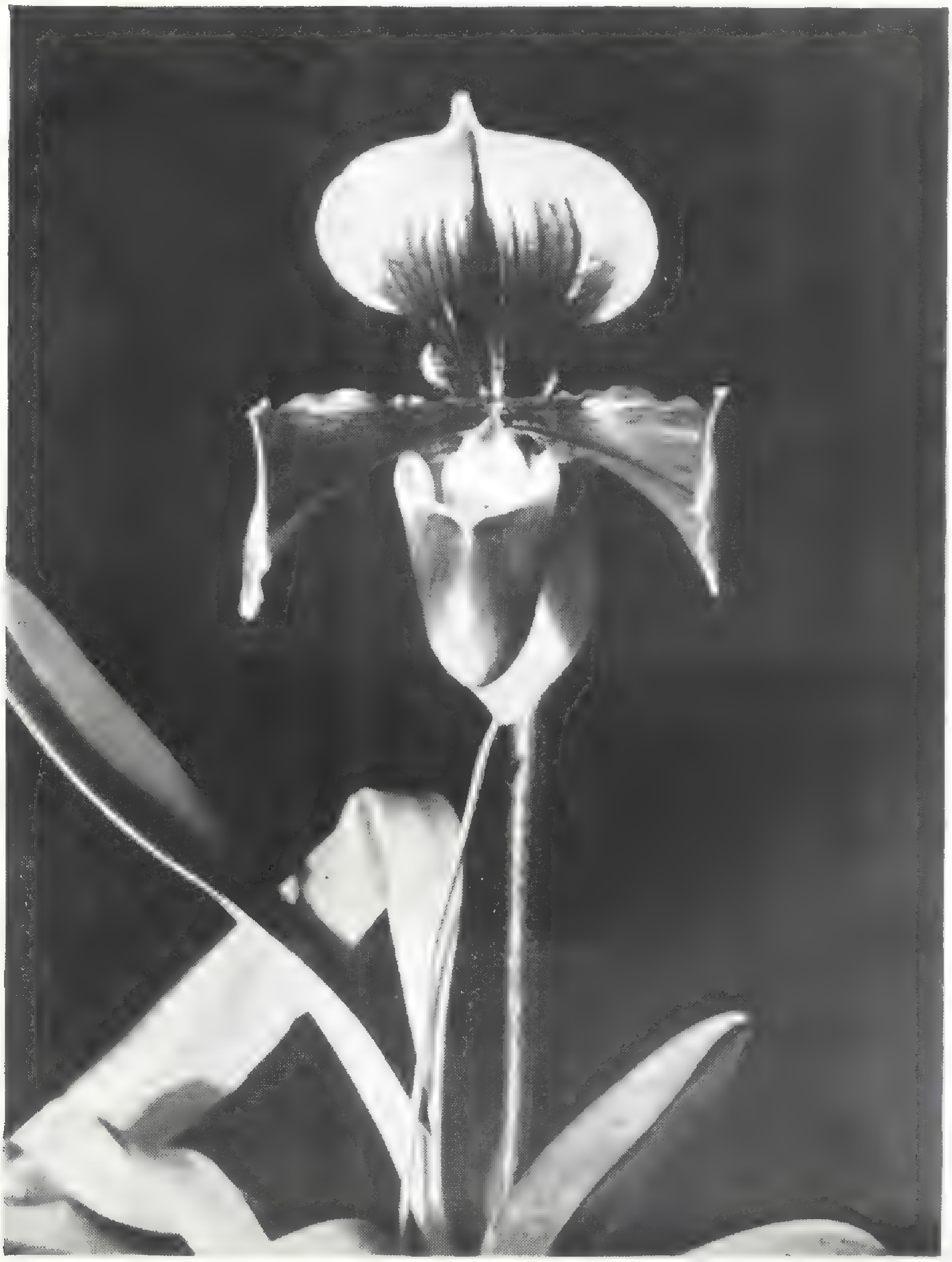

Fig. 5. × *P.* (Elsinore × Cardinal Mercier), 39 chromosomes.

Two examples of non-reduction are apparent in table II. *P. Harrisianum* (*P. villosum* 26 × *P. barbatum* 38) would be expected to have 32 chromosomes and Eleanor Francino reports that to be the case (Nuova Gior. Bot. Ital., vol. 49, pp. 189–238. 1934). However, the one plant of this cross from which root tips were obtained in England (Kew Gardens) proved to have 51 chromosomes. When the five different forms of this hybrid here at the Missouri Botanical Garden were investigated, two were found to have 32 chromosomes, two had 45 chromosomes and one had 51 chromosomes (table II). The two forms with 32 chromosomes (*albescens* and *nigrum*) must be regarded as "normal" for this cross as they have received the normal reduced complement from each parent (19 from *P. barbatum* and 13 from *P. villosum*). On the other hand, the two forms with 45 chromosomes (*superbum* and "yellow type") must have received a double complement of 26 chromosomes from *villosum*, but only a single of 19 from *barbatum*, while the number of the form *marginale* can only be explained by assuming that it had received a double complement of 38 from *barbatum* and a single of 13 from *villosum*. As would be expected, the difference in chromosome numbers is reflected in the appearance of the plants. The forms *superbum* and "yellow type" are more *villosum*-like in general appearance than those having a majority of *barbatum* chromosomes.

The other case of non-reduction is *P. Rosettii* (*P. insigne Sanderianum* × *P. Maudiae*). Although the chromosome number has not been determined for the *Sanderianum* variety of *insigne*, it is very unlikely that it is polyploid for it is the weakest of all the yellow forms of *P. insigne* and therefore has practically disappeared from culture. The chromosome numbers for five different forms of × *P. Maudiae* have been determined and found to be 34, as would be expected for hybrids between a 32- and a 36-numbered species. One would expect *P. Rosettii* to have around 30 chromosomes, but the two forms of the hybrid investigated proved to have 46 or 47, indicating that pollen grains from *Maudiae* with 33 or 34 chromosomes had functioned. *P. Maudiae* is partially sterile, producing but little seed per cross, and *P. Rosettii* is even more sterile, having given rise to very few seedlings since its introduction around 1905.

Another source of increased chromosome number particularly in the *insigne* group is the primary hybrid *Leeanum*, which was extensively grown and used as a parent at the same time as was *insigne* HAREFIELD HALL. The six forms of this hybrid investigated in this study have 28 chromosomes, which is what one would expect from a hybrid between a species with 30 chromosomes (*P. Spicerianum*) and one with 26 chromosomes (*P. insigne*). It has not been possible to investigate *P. Spicerianum*, but according to

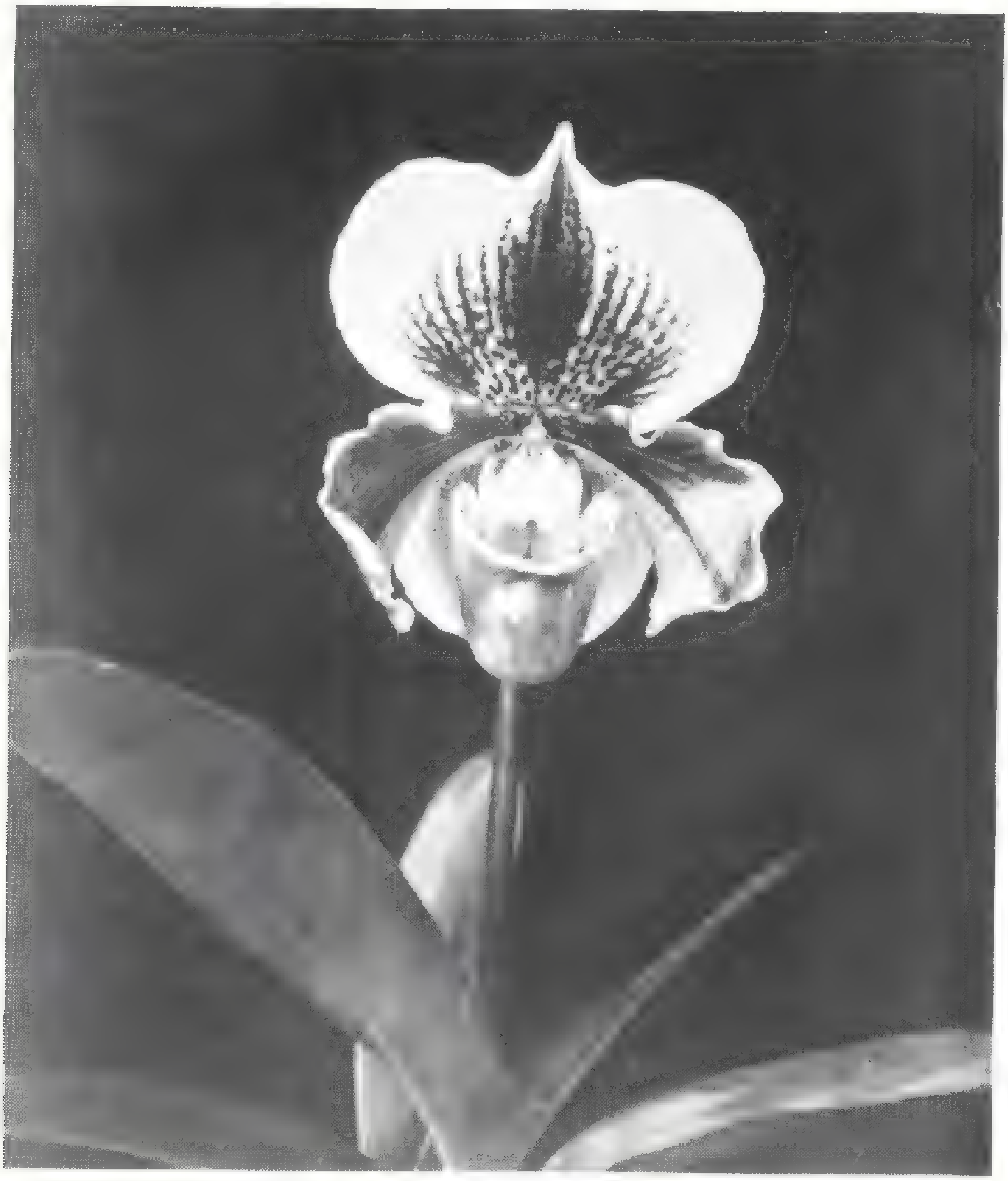

Fig. 6. × *P.* Lavamore (× *P.* Balaclava × chardmoore), 40 chromosomes.

Francino (Nuova Gior. Bot. Ital., vol. 38, pp. 154–212. 1931) it has 30 chromosomes. These two extra chromosomes in *Leeanum* (as compared to the rest of the *insigne* group of species) introduced again and again through hybridization (see chart for × *P. Tearlath*) might result in a slight increase in the chromosome number so that diploidy in the *insigne* group might reach 30, triploidy 45, and tetraploidy up to 60. The numbers found in this study reached only 27, 42, and 54, but Duncan reports up to 29, 42, and 56. In other plant families in which polyploidy has been studied extensively it has been found that when many seedlings are raised from tetraploid parents having the same number of chromosomes, occasional seedlings may have 1 or 2 chromosomes more or less than the parents. Therefore it is not at all unlikely that more exhaustive studies on the chromosome numbers in the *insigne* group will reveal a still greater scattering of the numbers extending below 39 and 52, as well as above. On the other hand, it would be surprising to find plants with less than 26, as loss of chromosomes at the diploid level usually does not permit the plant to survive.

One of the distinguishing features of *P. Spicerianum* is its very broad, almost orbicular dorsal sepal. Through the frequent use of the hybrid *Leeanum* (fig. 4) in hybridization this feature has been transmitted to many of our large-flowered hybrids (fig. 6).

The difficulty in learning exactly when or how the polyploidy originated in this genus is evident from the complex ancestry of most of our good present-day hybrids. This point is graphically illustrated by charts I and II, which give the pedigrees of two notably fine hybrids (TEARLATH and TROJAN), both of which are tetraploids. A chromosome plate of TEARLATH is shown in fig. 2d. It should also be borne in mind that unless one has access to the actual forms used in breeding, cytological investigations may not show when polyploidy first occurred, for with the present system of orchid nomenclature all seedlings of a given cross bear the same name even though they may differ in almost every conceivable respect. Only those forms that have been given variety names and are reproduced vegetatively can be considered as distinct entities whether they are grown in one country or another. *P. insigne* HAREFIELD HALL, × *P. Leeanum Clinkaberryanum*, and × *P.* CARDINAL MERCIER A. M.[3] variety are such entities unless they have been mislabelled.

The full extent of polyploidy in the genus Paphiopedilum cannot be determined from the work done so far. From the plants seen at exhibitions and pictured in dealers' catalogues one might be led to believe that the polyploid group, represented by the large, heavy-textured massive flowers, is the only one that really has any value. Although such forms may, with our present set of judging standards, be the ones most likely to win the awards, they have yet to prove themselves as cut-flower plants. Not only are the prices on such plants at the moment prohibitive from a grower's standpoint, but most of the very large forms do not produce anywhere near the number of flowers per square foot that the smaller ones do even when allowance is made for the difference in price of the flowers. Of course, the price of the plants will come down, but probably not for some time, because, due to the fact that the large-flowered hybrids do not make the many-growthed tufted plants that *P. insigne* and many of its early hybrids did, vegetative reproduction is slow and seed production is usually also much lower.

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[3] A. M. means Award of Merit, referring to award given by the Royal Horticultural Society unless otherwise stated.

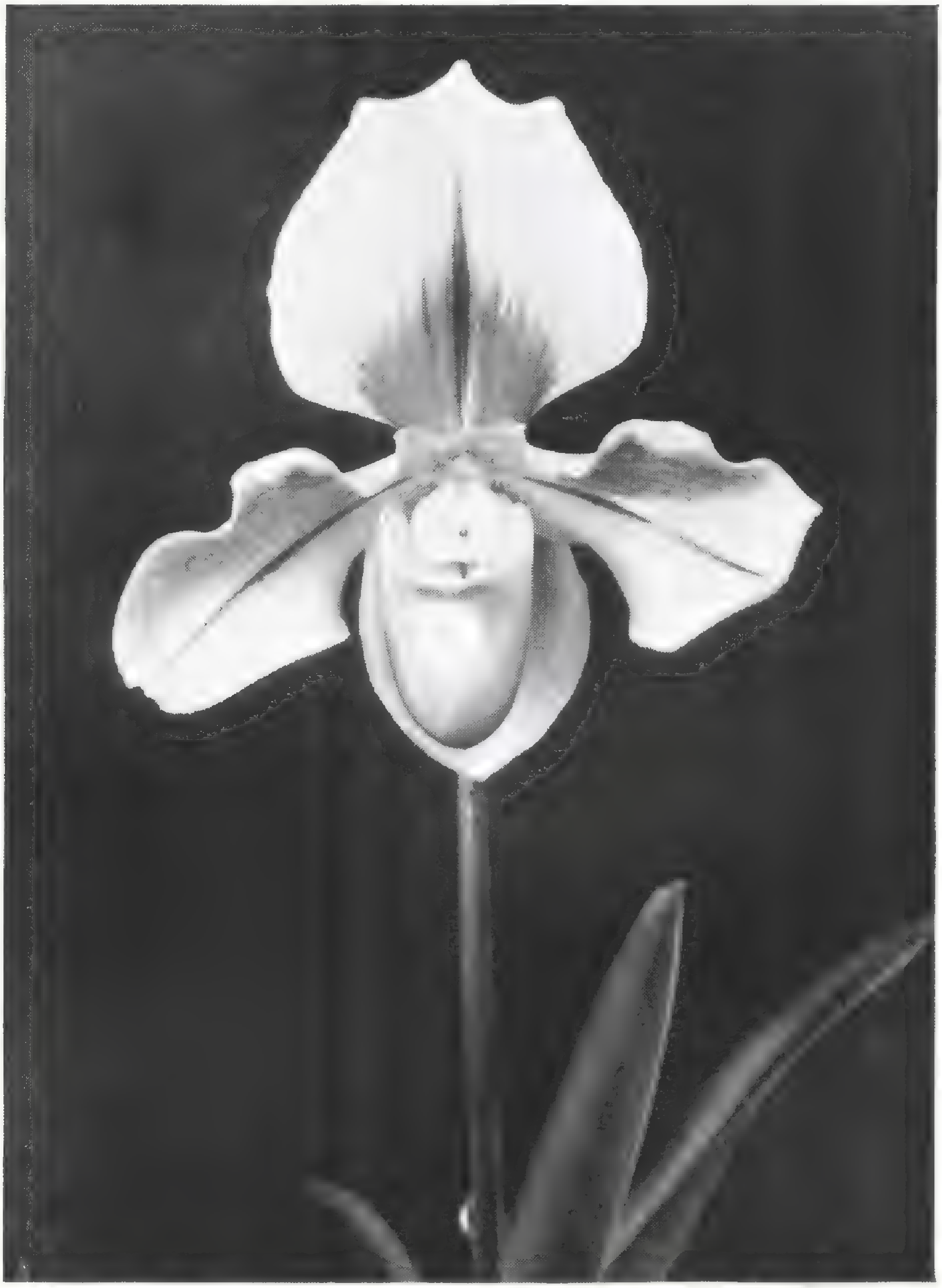


Fig. 7. × P. (CAMILLOT × MR. WU), 42 chromosomes.

The value of cytological and genetical studies therefore lies partly in the help they may offer relative to the choice of parents. It should be pointed out here that nine plants were chosen for this study because the growers said they were good seeders and fairly good parents generally. Five of these plants had 26 chromosomes and four had 52. There was no triploid nor any deviation from an even multiple of the basic set. Of course, the number of plants investigated is too small to be significant in itself, but from what is known of polyploidy in other plants it is fairly certain that good seeders are not likely to be found except in the groups where chromosome numbers are even multiples of the basic numbers. To be sure, triploids have produced many fine things as is evident from the performance of *insigne* HAREFIELD HALL and × CARDINAL MERCIER, but to my knowledge neither of these parents has ever produced many seedlings from any one cross.

Even though the amateur breeding orchids as a hobby obtains only a few seedlings from a cross, there is little source for complaint as long as he obtains at least some good hybrids. To the commercial breeder, on the other hand, particularly if he specializes in cut-flower types, the number of seedlings per cross becomes a matter of economic importance. Although there may be no absolute correlation between number of seedlings and quality, where plants produce seedlings of equal quality, the one producing the most per cross will certainly be the best one to work with from a commercial point of view. Of course, simply trying a number of choice plants as parents will eventually tell which ones are best with a degree of precision that cannot be approached by any other method, but it is also an expensive method. If the chromosome numbers were determined at the outset, some plants which from their appearance and ancestry might look promising as parents might be eliminated as being unlikely to produce sufficient seedlings. That is, while diploids and odd-numbered plants may produce occasional fine seedlings they probably never would produce any quantity of them. On the other hand, triploids and other odd-numbered individuals may be among the best flower-producers both in quantity and quality. In fact, triploids which average somewhat smaller and less massive than the tetraploids, but are faster-growers, might be the very ones that should be aimed at for cut-flower production.

The production of triploids at will is not always so easy as it sounds. There are not enough orchid data to predict just what is likely to happen, but from experience with other plants one should expect triploids to prevail when a tetraploid is crossed with a diploid. In some instances it appears to make little difference which way the cross is made, but in others the results differ depending on which plant is used as the seed plant. In general, the greatest number of seedlings and the highest percentage of triploids are produced when the tetraploid is used as the seed bearer.

Another field of orchid culture in which cytology will be of benefit is that of seed germination. A good deal of work is now being carried on in that field, but some of the data obtained would be of more value, both theoretical and practical, if the chromosomal constitution of the plants from which the seed were taken were definitely known. That is, polyploid plants in other families frequently produce seed which looks good, but does not germinate except under very favorable conditions. Since Paphiopedilum is one of the genera of orchids that gives the most trouble in seed germination, experiments designed to find the most favorable conditions should, at least in the initial stages, be based on seeds from plants known to be of simple chromosome constitution.

I wish to thank Gen. C. V. L. Lycett, secretary, and Mr. A. Simmonds, deputy secretary, of the Royal Horticultural Society, for their kind interest and help in connection with this study. It was a genuine pleasure to be accorded the privileges of a fellow of the Society during my stay in England.

I am also indebted to Dr. C. D. Darlington, Director of the John Innes Horticultural Institution, Merton Park, England, for generously providing me with laboratory facilities for this study. I am also indebted to Mr. F. F. La Cour of the same institution for help in developing suitable methods for chromosome determinations in orchids and for taking some of the photomicrographs.

Many growers and firms generously provided material and information relative to this study. Some of them are: H. G. Alexander Ltd., Westonbirt, Tetbury, Glos.; Armstrong & Brown, Tunbridge Wells, Kent; Georg Billström, Göteborgs Trädgardsförening, Gothenburg, Sweden; Charlesworth & Co. Ltd., Haywards Heath, Sussex; E. C. Cooper, Bricket Wood, Watford, Herts.; D. A. Cowan, Surbiton near London; R. Farmer, Orchid Dept., Dell Park, Englefield Green; Orchid Dept., Kew Gardens, London; A. J. Keeling & Son, Bradford, Yorks.; Mansell & Hatcher, Rawdon, Leeds, Yorks.; McBean's Orchids Ltd., Cooksbridge, Sussex; F. C. Puddle, Tal-y-Cafn, North Wales; Sanders Ltd., St. Albans, Herts.; W. Sterling, Whatcroft Hall, Northwich, Chesh.; Stuart Low Co., Crowborough, Sussex; Gurney Wilson, Hove, Sussex; all in England except where otherwise noted.

My colleague, George Pring, has been very helpful with information relative to plants in the Missouri Botanical Garden collection and another of my colleagues, Ladislaus Cutak, has kindly taken some of the photographs.

This study was in part financed by a grant from the John Simon Guggenheim Foundation and in part by a grant from the Friends of the Garden fund.

TABLE I

	Chromosome number
P. barbatum (Lindl.) Pfitz.	38
P. Boxallii (Reich. f.) Pfitz.	26
P. bellatulum (Reich. f.) Pfitz.	26
P. callosum (Reich. f.) Pfitz.	32
P. callosum var. *Sanderae* Hort.	32
P. callosum selected form	32
P. Curtisii (Reich. f.) Pfitz.	36
P. Curtisii var. *Sanderae* Hort.	36
P. Delenatii Guill.	26
P. Fairieanum (Lindl.) Pfitz.	26
P. insigne (Wall.) Pfitz. (six different unnamed selections)	26
P. insigne var. HAREFIELD HALL Hort.	39
P. insigne var. LAURA KIMBALL Hort.	26
P. insigne var. ROYALTY (LAURA KIMBALL × *Sanderae*)	26
P. insigne var. *Sanderae*	26
P. insigne var. *Sythethense* Hort.	26
P. insigne var. *Tonbridgense* Hort.	26
P. Laurenceanum (Reich. f.) Pfitz.	36
P. niveum (Reich. f.) Pfitz.	26
P. villosum (Lindley) Pfitz.	26

TABLE II

	Chromosome number
× *P. Actaeus* BIANCA (*insigne Sanderae* × *Leeanum* PROSPERO)	26
× *P. Actaeus* BIANCA (*insigne Sanderae* × *Leeanum* PROSPERO)	27
× *P. Actaeus* ST. ALBAN (*insigne* HAREFIELD HALL × *Leeanum Clinkaberryanum*)	28
× *P. Actaeus* ST. ALBAN (same parentage as preceding)	39
× *P.* ALMA GAEVERT (*Lawrenceanum* × *Maudiae*)	36
× *P. Harrisianum albescens* (*barbatum* × *villosum*)	32
× *P. Harrisianum nigrum* (*barbatum* × *villosum*)	32
× *P. Harrisianum* "Yellow type" (*barbatum* × *villosum*)	45
× *P. Harrisianum superbum* (*barbatum* × *villosum*)	45
× *P. Harrisianum marginale* (*barbatum* × *villosum*)	51
× *P. Holdenii* (*Maudiae* × *callosum*)	34
× *P. Leeanum aureum* (*insigne* × *Spicereanum*)	28
× *P. Leeanum Clinkaberryanum* (*insigne* var. HAREFIELD HALL × *Spicerianum*)	28
× *P. Leeanum Engelbartii* (*insigne* × *Spicerianum*)	28
× *P. Leeanum erectum* (*insigne* × *Spicerianum*)	28
× *P. Leeanum giganteum* (*insigne* × *Spicerianum*)	28
× *P. Leeanum* PROSPERO (*insigne Sanderae* × *Spicerianum*)	28
× *P. Maudiae* (*callosum* var. *Sanderae* × *Lawrenceanum* var. *Hyeanum*)	34
× *P. Maudiae* DELL variety (*callosum* var. *Sanderae* × *Lawrenceanum* var. *Hyeanum*)	34
× *P. Maudiae magnificum* (*callosum* var. *Sanderae* × *Lawrenceanum* var. *Hyeanum*)	34
× *P. Maudiae* WESTONBIRT variety (*callosum* var. *Sanderae* × *Lawrenceanum* var. *Hyeanum*)	34
× *P. Maudiae coloratum* (*callosum* × *Lawrenceanum*)	34
× *P. Rosettii* var. GOLIATH (*insigne Sanderianum* × *Maudiae*)	46–47
× *P. Rosettii* var. *splendidissimum* (*insigne Sanderianum* × *Maudiae*)	46–47

CHART I

- Tearlath
  - Balaclava
    - Gwen Hannen
      - Christopher
        - Leeanum
          - insigne
          - Spicerianum
        - Actaeus
          - Leeanum
            - insigne
            - Spicerianum
          - insigne
      - Florence Spencer
        - Actaeus Langleyense
          - *i.* Sanderae
          - Leeanum
            - insigne
            - Spicerianum
        - Memoria Jerninghamiae
          - Spicerianum
          - Winnianum
            - Druryi
            - villosum
    - Warrior
      - Alcibiades
        - Leeanum giganteum
          - insigne
          - Spicerianum
        - Mons. de Curte
          - Boxallii
          - insigne
      - Lord Wolmer
        - Leeanum
          - insigne
          - Spicerianum
        - Hera
          - Boxallii
          - Leeanum
            - insigne
            - Spicerianum
  - Nancie Gamble
    - Anselm
      - nitens
        - insigne
        - villosum
      - Pyramus
        - Hera Euryades
          - Boxallii
          - Leeanum
            - insigne
            - Spicerianum
        - Mrs. Wm. Mostyn
          - Calypso
            - Boxallii
            - villosum
          - Leeanum
            - insigne
            - Spicerianum
    - Pyramus
      - Hera Euryades
        - Boxallii
        - Leeanum
          - insigne
          - Spicerianum
      - Mrs. Wm. Mostyn
        - Calypso
          - Boxallii
          - villosum
        - Leeanum
          - insigne
          - Spicerianum

CHART II

- Trojan
  - Cardinal Mercier
    - ?
    - Lathamianum
      - Spicerianum
      - villosum
  - Gerda
    - Garibaldi
      - Bronzino
        - ?
        - ?
      - Earl of Tankerville
        - nitens
          - insigne
          - villosum
        - exul
    - Swallow
      - Satyr
        - Beryl
          - Beckmannii
            - bellatulum
            - Boxallii
          - Mrs. Wm. Mostyn
            - Calypso
              - Boxallii
              - villosum
            - Leeanum
              - insigne
              - Spicerianum
        - Hera
          - Boxallii
          - Leeanum
            - insigne
            - Spicerianum
      - Swallowtail
        - Mons. de Curte
          - Boxallii
          - Spicerianum
        - Fairieanum

SOME SMEAR TECHNICS FOR COUNTING CHROMOSOMES IN ORCHIDS

GUSTAV A. L. MEHLQUIST

In recent years the ranks of orchid enthusiasts have been considerably swelled by a number of professional people, doctors, chemists, pharmacists, etc., who, in the course of preparation for their careers, have learned to appreciate the need for a more thorough knowledge of the principles underlying the growth and reproduction of plants. Many of these people, together with some of the more far-sighted commercial growers, have turned their attention to a study of the mechanism of inheritance in orchids.

An important preliminary step in the study of inheritance in plants is a knowledge of the number and behavior of the chromosomes which are now known to act as carriers of the hereditary units commonly termed *genes*. The manner in which these genes are transmitted from generation to generation depends upon the behavior of the chromosomes.

It is partly in response to inquiries and partly because of our desire to further the interest in studies relative to inheritance in plants that these methods for fixing and staining chromosomes are published at this time. The methods are not new; they are merely adaptions and modifications of methods that have been developed for the study of other plants.

Three stains that have been used widely in recent years are *carmine*, *orcein* and *lacmoid*. Of these carmine is the oldest having been used as a stain for chromatin in 1880 by the German botanist Schneider. It was given a great impetus in 1926 by the American cytologist Belling, who found that the addition of a small amount of iron greatly increased the affinity of the chromosomes to this stain. Orcein and lacmoid are of more recent introduction. Both stains were first used by Mr. F. F. La Cour of the John Innes Horticultural Institution in England. During my stay there this summer Mr. La Cour was most helpful in suggesting modifications of existing technics to cope with the problems in orchids.

All three stains should be kept in tightly stoppered bottles in a cool place. From these stock solutions small amounts are drawn and diluted as needed. The stains are made up as follows:

Carmine.—Dissolve ½ gram carmine in 50 cc. *hot* glacial acetic acid, allow to cool and filter into a bottle just large enough to accommodate the solution.

Lacmoid and Orcein.—Dissolve 1 gram of the dry stain in 50 cc. *hot* glacial acetic acid. Allow to cool and filter as above.

The material used for chromosome studies should be killed and fixed before staining is attempted. Various mixtures were tried but the best results were obtained with the following fluid:

6 parts of ethyl alcohol (100 per cent is best but 95 per cent will do).

3 parts of chloroform.

1 part of carmine solution as described above.

This mixture will keep for some time at low temperatures but is most effective if used immediately after preparation.

Young flower buds can be used for chromosome counts, but as most of the commonly grown orchids produce relatively few flowers, young roots are more often used. Active root tips about ½ inch long are cut from the plants with a knife. The front quarter-inch of the tips is then quartered by means of a razor blade and the pieces dropped directly into a vial or small bottle containing fixing fluid prepared as directed above. The amount of fluid should be not less than ten times the volume of the root pieces. The vial should be tightly corked and, in the case of Cymbidium, Paphiopedilum (Cypripedium), and other semi-terrestrial and terrestrial orchids, should be allowed to stand in a cool place for 24–48 hours before staining is attempted. On the other hand, roots of Cattleya, Phalaenopsis and other epiphytes should, if possible, be stained after being in the fixing fluid for only one-half to two hours. With some epiphytes equally good results have been obtained when pure glacial acetic acid was used instead of the carmine solution. When the root tips have been in the fixing fluid the required length of time they are ready to be stained. A simple method is as follows:

1. On a small (1½–2 inch) watch-glass put 4 drops of diluted stain (1 part stain from stock bottle and 1 part distilled water) and 1 drop of 10 per cent hydrochloric acid. If many tips are to be stained at one time, use 8 drops of stain and 2 drops of acid. The purpose of the hydrochloric acid is to soften the tissues so that they may be smeared more readily.
2. With a pair of tweezers remove the quartered tips from the fixing fluid and place them in the stain on the watch-glass so that the tip end of the sections point toward the center of the glass.
3. Heat the watch-glass *gently* over an alcohol or gas flame until the stain begins to smoke (do not allow to boil).
4. Leave the tips in the heated stain for 20 minutes to one hour. If the stain evaporates add a drop or two more of stain, but no more hydrochloric acid. The tips must not be allowed to dry. (Roots of other plants than orchids may be sufficiently stained in 5 or 10 minutes.)
5. At the end of 20 minutes remove one tip from the watch-glass and place it on a *clean* slide. With a scalpel or knife remove the front 1–1½ mm. (about 1/16 inch) from the tip; the rest is discarded.

Add a small drop of stain and with the flat end of the handle of a dissecting needle thoroughly squash the tip. (A needle with a wooden handle can be used, but one of bone or plastic is more easily kept clean.)

6. Cover the mashed tips with a clean cover slip (#0 or #1) 16–18 mm. square. Press down on the cover slip rather hard through several layers of blotting paper or paper towels, but avoid sideways movement. If so much of the stain is pressed out that large air bubbles appear, place a small drop of stain next to the cover slip. If the slide and cover slip are clean the fresh stain will seep under the slip without distorting the material.
7. Warm the slide gently two or three times over a flame (do not allow it to boil) and examine it under the microscope. The heat will serve to precipitate the stain on the chromosomes but usually clears the surrounding cytoplasm. The orcein stain must be handled with care for if it is heated too much the chromosomes often lose the stain altogether. Carmine and lacmoid, on the other hand, stand considerable heating. It should be borne in mind that materials stained in carmine may deepen in color during the next 24–48 hours so that a slide which at first appears too light may be just right the next day or two.
8. If after a preliminary examination under the microscope the slide is found satisfactory it should be sealed by placing a sealing fluid around the edges of the cover slip. A suitable sealing fluid is made as follows: Mix 10 grams gelatin, 10 cc. Sorbital, 50 cc. glacial acetic acid, 60 cc. distilled water. Add sufficient orcein or lacmoid to give the mixture a color similar to that of the stain used on the slide. Equal parts of paraffin and gum mastic can also be used for sealing but that mixture is somewhat more difficult to apply. If properly sealed the slides will keep in good condition in a cool place from 10–20 days, but they should be "studied" as soon as possible.

The choice of stain depends on the material under investigation. Paphiopedilum roots stain well with any of the stains mentioned. However, as it becomes progressively more difficult to stain with orcein the longer the material remains in the killing and fixing fluid, orcein should be used only when the tips can be stained and smeared within one to two hours after removal from the plant. With the epiphytic genera such as Cattleya, Phalaenopsis and others, the orcein stain has so far proved best. On the other hand, with Cymbidium and many of the terrestrial genera best results have been obtained by the use of lacmoid after leaving the material for 24–72 hours in the fixing fluid containing carmine.

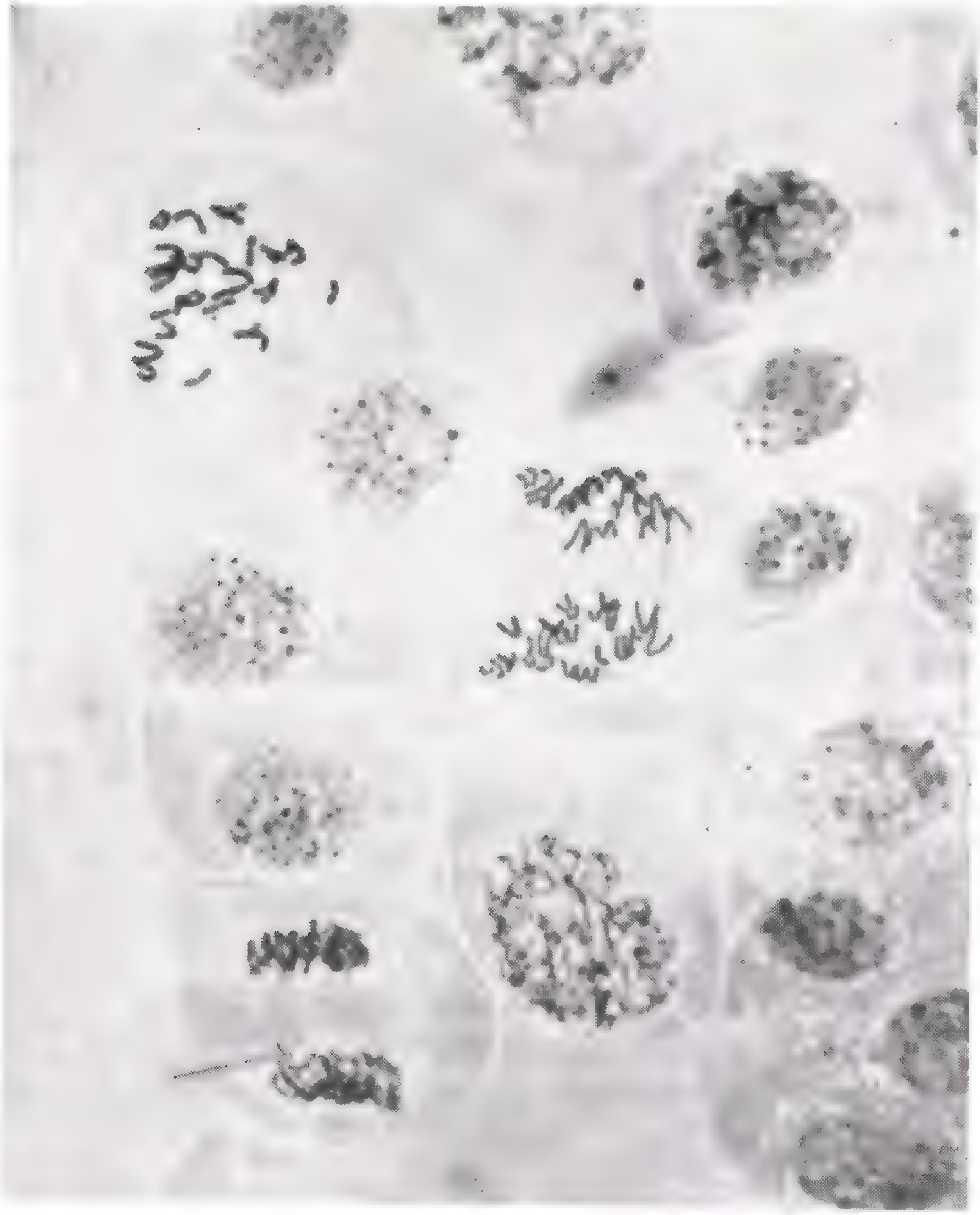


Fig. 8. *Paphiopedilum insigne*, enlarged about 800 times: lower center, prophase; upper left, metaphase showing 26 chromosomes; center, anaphase, 26 chromosomes going to each pole; lower left, telophase. The other nuclei are in resting stage.

Chromosome counts of Paphiopedilum which has rather large chromosomes (see figs. 1, 2 and 8) can be made on good slides under the high dry objective and 15× eyepieces giving a total magnification of 600 times, but for critical counts an oil-immersion objective and 15× eyepieces, giving a magnification of about 12–1400 times, is necessary. For all the other genera studied so far an oil-immersion objective is necessary before any counts can be made. Cymbidium chromosomes are best counted in the late prophase stage as only then are they sufficiently spread apart; at metaphase they are so closely bunched together as to make accurate counting very difficult. In all other genera studied the metaphase stage has proved the best for counts although in Paphiopedilum an occasional anaphase is sometimes clear enough to show all the chromosomes (fig. 1c).

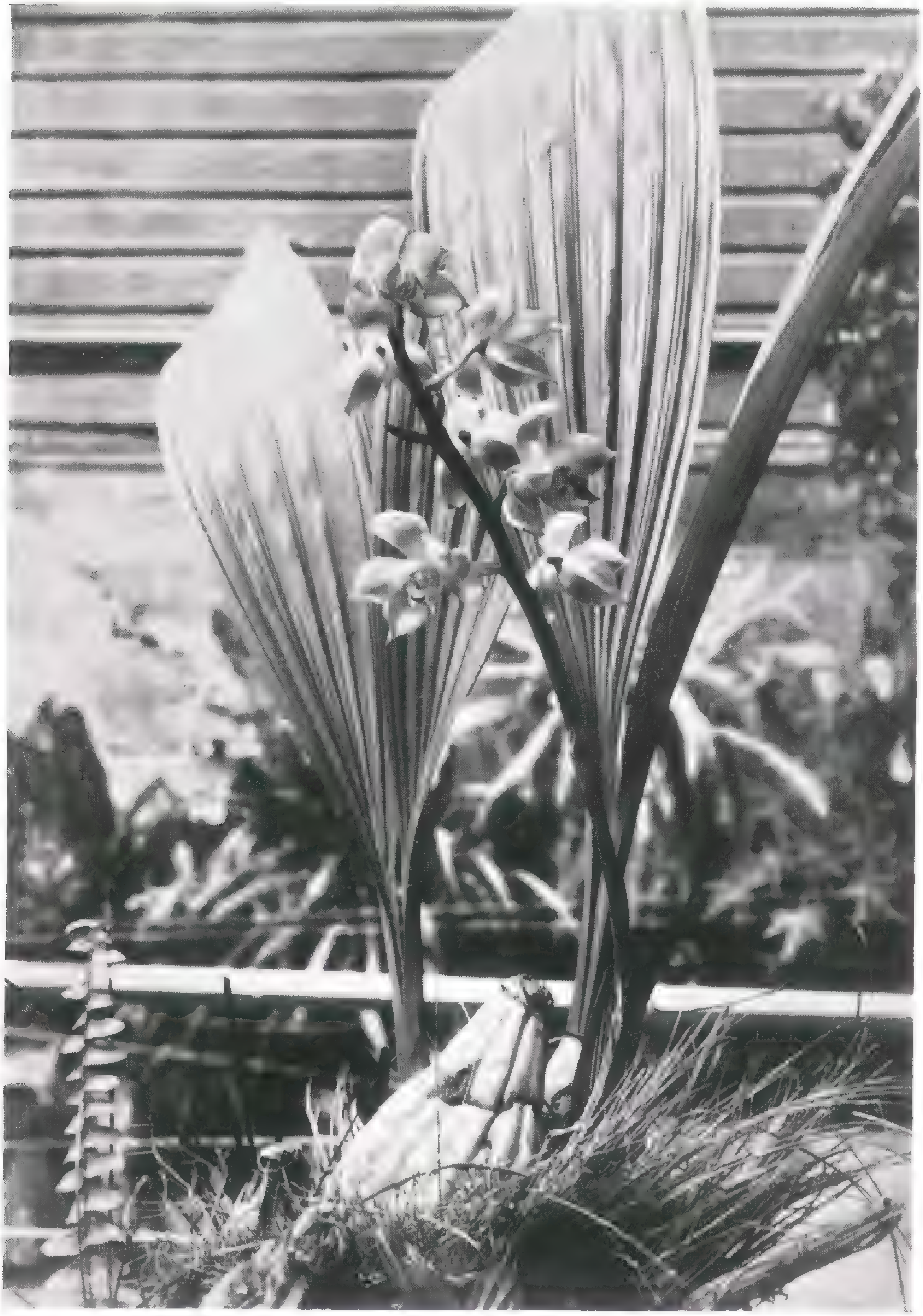
For a discussion of those cytological features with which any one contemplating chromosome counts should be familiar, "Fundamentals of Cytology," by Lester W. Sharp, McGraw-Hill Book Co., is recommended. Smear technics with particular reference to acetocarmine have been recently reviewed in *Stain Technology*, vol. 22, pp. 17–31, by Luther Smith of Washington State College.

THE LOST NEOMOOREA

PAUL ALLEN

When the writer took over the Missouri Botanical Garden Tropical Station, in Balboa, Canal Zone, in 1936, a few orchid photographs were found in the Station residence, among which was a fine flowering representation of *Neomoorea irrorata,* a robust orchid presumably confined to South America. A little exploration about the Station grounds uncovered a single live plant of this rarity, and two others were subsequently seen in the collections of Mr. A. M. Bouche and Mr. Henry Butcher, both enthusiastic Canal Zone orchid collectors. They reported the plants as being of rare occurrence near the mouth of the Rio Trinidad on Gatun Lake, where, they thought, Mr. Powell or Mr. Hunter had obtained the specimen in the Station collection. Although the plants were tried in every possible situation, they refused to flower and were eventually lost.

When Dr. Louis O. Williams began his work on the Panamanian orchids for the "Flora of Panama" now in progress, I sent him the Neomoorea photograph, together with such information as I had, asking him if any herbarium specimen was on file at the Garden, or at the Botanical Museum at Harvard. I was supposing of course that if Mr. Powell or Mr. Hunter had photographed such an unusual find that a permanent specimen had doubtless been made at the same time as a voucher for the occurrence of the genus in North America. Although Dr. Williams was willing to accept the photograph as evidence, no specimen was found, and there remained the tantalizing question as to whether authentic herbarium material existed from Panama of this rare South American genus. Fortunately, specimens deposited in a great herbarium such as that of the Missouri Botanical Garden "may sometimes become misplaced, but are never lost." Recently on going through the orchid specimens on file preparatory to the final work on the last portion of the manuscript of the "Orchids of Panama," I noticed a folder marked Neomoorea, but labeled from South America. You may imagine my delight on opening the folder to find two beautiful herbarium specimens of *Neomoorea irrorata,* collected by Mr. A. A. Hunter and very



Neomoorea irrorata

evidently made from the plant originally photographed. Some one had written "cultivated" on the herbarium sheet, which was true enough in that the plants had evidently been flowered at the Tropical Station in Balboa, but from locally collected material and not "cultivated" from South American sources as someone had evidently thought.

In any event, this excellent specimen, so long hidden in the orchid files, will constitute the only authentic record of this rare handsome orchid for Panama and North America, and proves once again the value of a permanent place such as is afforded by a great herbarium for the preservation of plant records.

NOTES

Dr. Edgar Anderson, Geneticist to the Garden, attended the meeting of the Hybrid Seed Corn Division of the American Seed Trade Association, held at Chicago, December 2.

Mr. Felix Agramont, of the Escuela Nacional de Agricultura, Mexico, who has been studying corn in Iowa since last July under Dr. Anderson's general direction, arrived at the Garden in late November to take graduate work in the Henry Shaw School of Botany for six months. Mr. Agramont is in the United States on a fellowship from the Rockefeller Foundation.

The fourth number of volume XXXIV of the ANNALS OF THE MISSOURI BOTANICAL GARDEN was recently issued, containing two papers: Some Dynamics of Leaf Variation in *Asclepias tuberosa,* by Robert E. Woodson, Jr.; and Field Studies of Guatemalan Maize, by Edgar Anderson.

Mr. Paul H. Allen, Tropical Collector to the Garden, has recently accepted a position with the United Fruit Co., at La Lima, Honduras. Before taking up his new position he spent some time in the Garden library and herbarium working over the orchids of Panama in preparation for his contribution to Woodson's and Schery's "Flora of Panama."

The Tropical Water-lilies (Nymphaeas) remained in bloom at the Garden until they were dug from the pools on November 13. This is about two weeks later than in 1946, and the latest flowering date on record for this group of plants at the Garden. The giant water-lilies (Victorias) did not fare so well, their leaves and flowers having been affected by the cool nights in October.

Recent visitors to the Garden include Mrs. J. Norman Henry, well known in horticultural circles for her travels and plant introductions from the British Northwest and the southeastern United States; Mr. Orrin Henbest, graduate student, University of Illinois; Dr. L. C. Newell, Agronomist, Nebraska Agricultural Experiment Station, Lincoln; Dr. L. J. Gier, of William Jewell College, Liberty, Mo.; Dr. Carl O. Sauer, Head Department of Geography, University of California, Berkeley.

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date until his death in 1889 it was maintained under his personal direction. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was chosen by Mr. Shaw and he definitely indicated that he wished it called by that name. The Garden passed at his death into the hands of a Board of Trustees, designated in Mr. Shaw's will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will the immediate direction of the Garden is vested in a Director, appointed by the Board. The Garden receives no support from city or state but is maintained almost exclusively from the estate left by Henry Shaw. Since 1939 many Garden Clubs and interested individuals have contributed to a "Friends of the Garden Fund" which is used in developing the new Arboretum, located at Gray Summit, Mo. The Arboretum (1) serves as a source of plants, trees and shrubs for the city Garden; (2) affords areas for gradually establishing a pinetum, a wild-flower reservation and various other features on a scale not possible in the city; (3) provides greenhouses for some 20,000 orchid plants.

The city Garden comprises 75 acres, where about 12,000 species of plants are grown, both out of doors and under glass. It is open every day in the year except New Year's Day and Christmas; week days, 8:00 a. m. until 7:00 p. m.; Sundays, 10:00 a. m. until 7:00 p. m. The greenhouses are closed every day at 5:00 p. m.

The main entrance to the Garden is at Tower Grove and Flora Place, on the Sarah bus line (No. 42). The Tower Grove bus (No. 21), direct from downtown, passes within three blocks of the main entrance.

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